ARMY ORDNANCE

The Journal of the Army Ordnance Association—Now in its Nineteenth Year of Publication. Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guaranty of Peace

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The Army Ordnance Association

THE Army Ordnance Association is a national organization of American citizens pledged to industrial preparedness for war as our nation's strongest guaranty of peace.

The Association endeavors to keep alive an interest in and knowledge of the design, production and maintenance of munitions. Other than a few manufacturing arsenals—six in all—there is no peace-time industry for the production of ordnance. Should war unhappily come again, industrial America will be called upon to produce munitions in great quantity and of intricate and unusual design. In an emergency, time will not permit careful study or long preparation for the production of munitions. The problem is one of vital concern.

The Army Ordnance Association believes that the solution of this problem, based on experience, lies in an active organization at all times coöperating with the Government. The principal objective of the Association is an active membership of American citizens, on whom the duty of design and production of munitions will fall in war, who will have an accurate and authentic knowledge of the complex requirements of ordnance. "Peace insurance" in this form is the foremost aim of the Army Ordnance Association.

The Association is devoted solely to the national defense; it has no commercial interests, no political alliances, and no religious affiliations. It is not operated for profit: its income is expended in furthering its aims. Its officers and directors serve without remuneration. Membership, to which American male citizens are eligible, is four dollars a year. (Application on page 318.)

ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the nation's strongest guaranties of peace;

To keep available the highly specialized knowledge necessary for arming the manhood of the nation by stimulating interest in the design and production of ordnance material;

To promote mutual understanding and to effect coöperation with American scientists, inventors, engineers and manufacturers in civil life and the Regular and Reserve officers of the Ordnance Department;

To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects;

To assist in developing and maintaining an efficient personnel, both commissioned and enlisted, for the units required for Ordnance Field Service in the event of an emergency;

To commemorate the services rendered by the industry of the nation and by the officers and civilian employees of the Ordnance Department in the wars in which the United States has been engaged.

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Official Photograph, U. S. Army Air Corps

Maj. Gen. Henry H. Arnold

Chief of the Air Corps, U. S. Army

ARMY ORDNANCE

Volume XIX MARCH-APRIL, 1939 No. 113

The President's Defense Message

Critical Items of Ordnance—Long Needed—To Be Procured

TO the Congress of the United States: In my annual message to this Congress I have spoken at some length of the changing world conditions outside of the American Hemisphere which make it imperative that we take immediate steps for the protection of our liberties.

It would be unwise for any of us to yield to any form of hysteria. Nevertheless, regardless of political affiliations, we can properly join in an appraisal of the world situation and agree on the immediate defense needs of the Nation. It is equally sensational and untrue to take the position that we must at once spend billions of additional money for building up our land, sea, and air forces on the one hand, or to insist that no further additions are necessary on the other.

What needs to be emphasized is the great change which has come over conflicts between nations since the World War ended, and especially during the past five or six years.

Those of us who took part in the conduct of the World War will remember that in the preparation of the American armies for actual participation in battle, the United States, entering the war on April 6, 1917, took no part whatsoever in any major engagement until the end of May 1918. In other words, while other armies were conducting the actual fighting, the United States had more than a year of absolute peace at home without any threat of attack on this continent, to train men, to produce raw materials, to process them into munitions and supplies, and to forge the whole into fighting forces. It is even a matter of record that as late as the autumn of 1918, American armies at the front used almost exclusively French or British artillery and aircraft.

Calling attention to these facts does not remotely intimate that the Congress or the President have any thought of taking part in another war on European soil, but it does show that in 1917 we were not ready to conduct large-scale land or air operations. Relatively, we are not much more ready to do so today than we were then—and we cannot guarantee a long period, free from attack, in which we could prepare.

I have called attention to the fact that "we must have armed forces and defenses strong enough to ward off sudden attack against strategic positions and key facilities essential to insure sustained resistance and ultimate victory." And I have said, "We must have the organization and location of those key facilities so that they may be immediately utilized and rapidly expanded to meet all needs without danger of serious interruption by enemy attack."

I repeat that "there is new range and speed to offense." Therefore, it has become necessary for every American to restudy present defense against the possibilities of present offense against us.

Careful examination of the most imperative present needs leads me to recommend the appropriation at this session of the Congress, with as great speed as possible, of approximately $525,000,000, of which sum, approximately $210,000,000 would be actually spent from the Treasury before the end of the fiscal year ending June 30, 1940. The survey indicates that of this sum approximately $450,000,000 should be allocated for new needs of the Army, $65,000,000 for new needs of the Navy, and $10,000,000 for training of civilian air pilots. The several items will be submitted to the appropriate committees of the Congress by the departments concerned, and I need, therefore, touch only on the major divisions of the total.

IN THE case of the Army, information from other nations leads us to believe that there must be a complete revision of our estimates for aircraft. The Baker Board report of a few years ago is completely out of date. No responsible officer advocates building our air forces up to the total either of planes on hand or of productive capacity equal to the forces of certain other nations. We are thinking in the terms of necessary defenses, and the conclusion is inevitable that our existing forces are so utterly inadequate that they must be immediately strengthened.

It is proposed that $300,000,000 be appropriated for the purchase of several types of airplanes for the Army. This should provide a minimum increase of 3000 planes, but it is hoped that orders placed on such a large scale will materially reduce the unit cost and actually provide many more planes.

Military aviation is increasing today at an unprecedented and alarming rate. Increased range, increased speed, increased capacity of airplanes abroad have changed our requirements for defensive aviation. The additional planes recommended will considerably strengthen the air defenses of the continental United States, Alaska, Hawaii, Puerto Rico, and the Canal Zone. If an appropriation bill can be quickly enacted, I suggest that $50,000,000 of the $300,000,000 for airplanes be made immediately available in order to correct the present lag in aircraft production due to idle plants.

Of the balance of approximately $150,000,000 requested for the Army, I suggest an appropriation of $110,000,000 to provide "critical items" of equipment which would be needed immediately in time of emergency and which cannot be obtained from any source within the time and quantity desired —material such as antiaircraft artillery, semiautomatic rifles, antitank guns, tanks, light and heavy artillery, ammunition, and gas masks. Such purchases would go far to equip existing units of the Regular Army and the National Guard.

I suggest approximately $32,000,000 for "educational orders" for the Army; in other words, to enable industry to prepare

for quantity production in an emergency of those military items which are noncommercial in character and are so difficult of manufacture as to constitute what are known as "bottle necks" in the problem of procurement.

The balance should be used, I believe, for improving and strengthening the seacoast defenses of Panama, Hawaii, and the continental United States, including the construction of a highway outside the limits of the Panama Canal Zone, important to the defense of the zone.

The estimated appropriation of $65,000,000 for the Navy should be divided into (a) $44,000,000 for the creation or strengthening of Navy bases in both oceans, in general agreement with the report of the special board, which has already been submitted to the Congress; (b) about $21,000,000 for additional Navy airplanes and air material tests.

Finally, national defense calls for the annual training of additional air pilots. This training should be primarily directed to the essential qualifications for civilian flying. In coöperation with educational institutions it is believed that the expenditure of $10,000,000 a year will give primary training to approximately 20,000 citizens.

New York Times

"There is New Range and Speed to Offense"

In the above recommendations for appropriations totaling $525,000,000 I have omitted reference to a definite need, which, however, relates to the implementing of existing defenses for the Panama Canal. The security of the Canal is of the utmost importance. The peace garrison now there is inadequate to defend this vital link. This deficiency cannot be corrected with existing forces without seriously jeopardizing the general defense by stripping the continental United States of harbor defense and antiaircraft personnel. The permanent garrison in the Canal Zone should be increased to provide the minimum personnel required to man the antiaircraft and seacoast armament provided for the defense of the Canal. Such personnel cannot be increased until additional housing facilities are provided—and, in the meantime, additional personnel must be trained. I recommend, therefore, an appropriation of $27,000,000 to provide an adequate peace garrison for the Canal Zone and to house it adequately. Five million dollars of this sum should be made available immediately in order that work on necessary construction can be initiated. All of the above constitutes a well-rounded program, considered by me as Commander in Chief of the Army and Navy, and by my advisers to be a minimum program for the necessities of defense. Every American is aware of the peaceful intentions of the Government and of the people. Every American knows that we have no thought of aggression, no desire for further territory.

Nevertheless, as the executive head of the Government, I am compelled to look facts in the face. We have a splendid asset in the quality of our manhood. But without modern weapons, and without adequate training, the men, however splendid the type, would be hopelessly handicapped if we were attacked. The young men of this Nation should not be compelled ever to take the field with antiquated weapons.

It would be economically unsound to provide in time of peace for all the modern equipment needed in a war emergency. But it would be nationally unsound not to provide the critical items of equipment which might be needed for immediate use, and not to provide for facilities for mass production in the event of war.

Devoid of all hysteria, this program is but the minimum of requirements.

I trust, therefore, that the Congress will quickly act on this emergency program for the strengthening of the defense of the United States.

Franklin D. Roosevelt.

The White House, *January 12, 1939.*

The Air Force Spreads Its Wings

The Pressing Problems of Development and Production

By Maj. Gen. Henry H. Arnold*

NO MORE sincere tribute can I pay the Army Ordnance Association than to say I long for the day when the Army Air Corps shall have the coöperation and support of a similar body devoted exclusively to the promotion of its interests and aims in the solution of its problems. In the meantime, the best possible substitute is to know of the interest of the Army Ordnance Association in those purposes and those problems. It is particularly appropriate to have the Los Angeles Post of the Army Ordnance Association on our side since the importance of Southern California in the airplane industry is comparable to that of the New England States for Ordnance matériel.

The President of the United States recently well said, "There is new speed and range to offense, therefore it has become necessary for every American to restudy present defense against the possibilities of present offense against us." Pursuant to the President's directives, we have recently submitted to the Congress a request for more than 3000 additional airplanes for the Army Air Corps, which would bring our total to about 5500 planes. This is the first step in our defense plans to meet that new threat.

The efficiency and effectiveness of our Air Force are based upon three considerations: (1) an adequate Air Force in being, (2) an adequate reserve of men and matériel, and (3) a trained aircraft industry of a proper size, well equipped to meet war-time requirements. By an adequate Air Force in being I mean one which is completely equipped with modern planes and which in addition has its full complement of trained combat and maintenance crews, and sufficient completed and well-equipped bases from which to operate and at which are installed the necessary repair, operation and maintenance facilities. An adequate reserve must consist not only of the necessary airplanes, but also of trained personnel for combat and maintenance crews and for station overhead. Ample productive capacity includes training schools for personnel and industrial establishments for the production of modern planes and equipment.

Experience during the World War and since has clearly shown that no matter how strong the military forces of a nation may be, unless there be a strong and efficient industry behind them, those military forces will inevitably be vanquished. A proper aviation industry is one not only sufficient for peace-time needs but one which is also capable of rapid expansion to meet a war emergency. The foundation stones of our Air Force are then: a sound program of personnel procurement and training, airplanes in being, and an aëronautic industry that will provide for our losses in war.

THE present procurement problem of the Air Corps is of two distinct parts. One concerns research and development, while the second is that of quantity or mass production of airplanes, engines and accessory equipment.

Our own experience and our observation of foreign experience have taught us one lesson thoroughly and well: The functions of experimentation and procurement must be definitely separated. The purposes of the development engineer and those of the production engineer are diametrically opposed. It is the job of the production engineer to achieve maximum production; the development engineer, on the contrary, is continually trying to improve the product. Improvement necessitates changes and, as you members of the ordnance profession can well appreciate, changes and quantity production are as incompatible as oil and water.

During the World War, aviation rapidly advanced to a point far beyond that which it would have achieved in a corresponding era of peace. In the United States, over a period of 19 months the industry grew from almost a nonexistent status to one which on Armistice Day, 1918, was producing airplanes complete with engines and equipment at the rate of 20,000 per year. From January 1, 1918 to November 11th of that same year, a total of 11,280 airplanes were constructed by the American aircraft industry.

During the past few years we have been witnessing in Europe a similar period of phenomenal advancement. The aircraft industry abroad is proceeding under "forced draft". Two years ago we could truthfully maintain that our Air Force was equipped with planes of a quality equal to or superior to those of any other nation. Our fighting planes were the envy of the world. Today, unfortunately, we cannot make those claims. Certain of the European nations are now producing in quantity airplanes which surpass in performance many of those with which our Air Force is now equipped. This is the direct result of the accelerated research and development programs which were initiated by those nations a few years ago.

Our aircraft industry possesses today engineering talent and skilled craftsmanship which are the equal of those to be found anywhere in the world. Our failure to keep abreast with development abroad is due, therefore, to our failure to give our program of research and development the emphasis which has been accorded these items abroad. Great Britain spent fifteen million dollars in its research laboratories on military aëronautics last year, while France is said to have spent more than ten million dollars. Our figure was but slightly more than six millions. Research and development in the Army Air Corps are centralized in the Air Corps Matériel Division located at Wright Field, Dayton, Ohio. That Division of my office is charged with the supervision of the development, procurement, storage, and issue of all Air Corps equipment.

A limited amount of research work is performed in the various research laboratories of this Division, but its major function in connection with research and development consists in coöperation with the aircraft industry and testing countless items of aircraft matériel submitted to it. The most important items submitted include airplanes for Air Corps competitions, engines for development or accessory test, accessories for installation on these engines, fuels and lubri-

*Chief of the Air Corps, U. S. Army. This is an address delivered at the annual meeting of the Los Angeles Post, Army Ordnance Association, Los Angeles, Calif., February 8, 1939.

cants, aircraft instruments, electrical and radio equipment, armament equipment, aërial photographic devices and supplies, and the basic materials used in fabrication of all this equipment.

Examples of basic research which have recently been carried on by the Matériel Division include the XC-35 supercharged cabin airplane built by the Lockheed Company in this area. This airplane flying at an altitude of about 30,000 feet is capable of maintaining an atmosphere equivalent to 12,000 feet in the cabin. Another important development was that of the automatic landing device which has made possible the successful landing of an airplane on a predetermined spot without manual control. The application of the tricycle landing gear to modern aircraft is another.

Official Photograph, U. S. Army Air Corps

A BOEING B-15, SUPER FLYING FORTRESS BOMBER, IN RECENT GHQ AIR FORCE MANEUVERS

TO SUCCESSFULLY carry out our proposed aircraft program we must immediately construct and install additional laboratory facilities at Wright Field. The present facilities must be modernized and expanded. Work is now under way on a new 400-mile-an-hour wind tunnel to replace the present one which is obsolete. A new testing laboratory is also under construction which will contain test facilities for aircraft engines up to 3000 horsepower.

Our program requires more, however, than laboratories and equipment. There must be a competent technical staff in order to attract and retain high-grade specialists, engineers and laboratory technicians. We must offer high salaries and reasonable chances of advancement.

Since our traditional military policy indicates that we shall not probably in the near future match airplane quantities with European powers, it is more important that we keep pace with the foreign field in research and development. A comparatively small investment in research today may pay off tomorrow in security dividends. It is our purpose so to increase the Air Corps facilities for research and development that our establishment can once more be considered the finest and most up to date in the world.

Here in brief outline are a few of our early objectives in the field of research and development: Wing slots and wing flaps and other high-lift devices will be given greater emphasis. Higher top speeds are accompanied by increased landing speeds. These improved high-lift devices are absolutely necessary in order to keep landing speeds within reasonable bounds.

New and improved materials and methods of construction must be found. Our present method, involving the use of hundreds of thousands of rivets, each of which must be driven and bucked by hand, is a long and expensive procedure. Improvements must be designed not only reducing the initial time factor in construction but also reducing the time required for daily maintenance and periodic overhaul.

Two classes of substitute materials in which we are now vitally interested are the stainless steels and plastics. Stainless steels are well adapted to resistance welding, while the advantage in plastics lies in the fact that large sections of airplanes could be molded in one piece. Present day so-called plastic airplanes are not truly plastic since they are built up on molds using alternate plies of wood between which are applied layers of a synthetic organic compound such as methacrylate resin, the whole section being reenforced with metal fabric and subjected to heat and pressure to obtain a homogeneous and moisture-resistant material.

The Air Corps has today several amphibian airplanes equipped with spot-welded stainless-steel wings and is now investigating the possibilities of constructing complete airplanes by the plastic method.

Considerable research work is being devoted to simplified and more reliable retractable landing gears. There has been much recent progress in connection with tricycle landing gears. This latest tricycle trend is a reversion to a style in vogue 25 years ago. Its application to present-day airplanes of all-metal skin-stressed construction and retractable landing gears, presents many problems which did not exist in the old days when one hundred miles per hour was spoken of in the same awe that we today reserve for speeds of five hundred miles an hour.

Official Photograph, U. S. Army Air Corps

THE CURTISS A-18, LATEST TWIN-ENGINE ATTACK AIRPLANE, WITH AN OPERATING SPEED OF OVER 200 MILES AN HOUR

THERE is the ever-present but important problem of cleaning up our designs from an aërodynamic point of view. Every possible bump must be removed. The air flow around the nose of the fillet which fairs the wing into the fuselage and over the ailerons and tail surface must be given careful study both in the wind tunnel and in flight.

Our effort to cut down drag and increase speed indicates research in burying the engine in the interior of the wing and driving the propellers by means of extension shafts. Air-duct cooling, which consists of mounting the radiator within the wing, is another subject of present concern. A radiator projecting out of the slip stream of an otherwise clean airplane, has always been a thorn in the side of the airplane designer.

In aircraft-engine development we are confronted with the problem of developing suitable engines of high horsepower. Our present-day requirements for planes possessing high speed, higher rate of climb and heavy load-carrying capacity, have created a real problem for the engine manufacturer. While the industry has swallowed this problem, it has not yet completely digested it.

Military aviation is perhaps more concerned with high-altitude performance than commercial aviation. The added feature of safety from antiaircraft fire at high altitudes makes for this difference. Engine performance at high altitude is attended by such problems as lock in the fuel lines which has necessitated the development of improved fuel systems of a new basic design. High-altitude engine development requires the construction of new and larger altitude test stands at the Matériel Division. Since this phase of engine development is so closely related to military requirements and only indirectly related to commercial aviation, it is not reasonable to expect the aviation manufacturers to provide all this expensive test equipment. We are therefore taking the initiative in this respect.

Our latest type of flying fortress capable of sustaining high performance at 22,000 feet is our latest example of successful high-altitude military aircraft.

The best installation of engines in airplanes, particularly with reference to the cooling of the engines under different conditions of flight, is a joint problem of prime importance to the airplane manufacturer and the Air Corps.

Suitable fuels and lubricants for high-output engines constitutes another pressing subject for research and development. An appreciable portion of the load of many military airplanes consists of fuel; consequently, fuel economy is of vital importance. The adoption of 100-octane fuel was an

important step in this development. It permits higher pressures and higher temperatures without detonation.

Closely allied to engine development is propeller development. Propellers must be provided capable of absorbing higher horsepowers. Propellers must be developed of lighter weight. An interesting project is now under way to extend the working portion of the propeller blade down to the hub of the propeller. Late development in aircraft and engine design has increased many fold the task of the instrument designer and manufacturer. New instruments are required; existing ones must be improved. Many of you are familiar with or have seen photographs of the instrument panels of modern transports or bombardment planes. The instrument requirements have become so great that in some of the largest airplanes, both commercial and military, it has been necessary to remove many of them from the pilot's panel and place them in a new compartment for a new member of the airplane crew—the engineer.

We must continue our development of instrument flying, de-icing, and automatic landing equipment as these three projects are essential to overcoming weather hazards.

THE second phase of our procurement problem, and one which is now extremely pressing, is that of expediting the production which would be required if our new program goes through. That program will require a considerable expansion of the Army Air Corps but fortunately our present aircraft industry is capable of producing at least 6000 planes a year of the types we require. Positively there will be no overload on industry as a result of this program.

These are the procurement principles which are basic:

(1) There must be a rigid segregation of development and production. We must eliminate the many changes which in the past, during the progress of production, have delayed the delivery of completed airplanes.

(2) The first necessity if the Air Corps is to be expanded, is a decision as to the numbers of the various types required and the military characteristics of those types—speed, range, bomb load, and performance. Decisions governing these important points have been made. When the money becomes available we shall be ready for full speed ahead.

(3) Our airplanes must be stripped of all nonessentials and our equipment limited to that vital to the performance of the military mission.

(4) We must encourage each manufacturer by definite assurance and commitments so that he can expand his plant to the extent required for efficient quantity production.

(5) The Government must work out a method whereby it can reimburse the manufacturer for the cost of development of purely military aircraft and accessories.

(6) More than one article of each prototype must be produced. The loss of an experimental plane in this area recently indicates the necessity for this precaution.

(7) Provision must be made which will permit the allocation of contracts for aircraft to manufacturers not now fully engaged. Our policy must be to take advantage of idle factories before greatly expanding factories now full to capacity.

(8) In the selection of types to be procured, emphasis must be placed on adaptability to quantity production. Where the decision rests between two models of a type, one of which presents fewer manufacturing difficulties than the second, the former must be selected for quantity production

Official Photograph, GHQ Air Force, U. S. Army

BOEING P-26A PURSUIT AIRPLANE DURING GHQ AIR FORCE MANEUVERS

unless there is a very great difference in its performance.

Since it is generally agreed, I believe, that there must be some healthy expansion of our aircraft industry, it is well to review several methods of accomplishing this result. Two such methods have been tried out recently, one in Germany and the other in England. Germany's method consists of placing the burden squarely on the shoulders of the aircraft industry and rendering such government aid as is necessary to see the project through. An important factor of the German system as we understand it, was the fact that the administration of the aircraft industry was left in the hands of those who were familiar with its methods and problems. Another point of interest was the complete separation of development and production.

In England, for various reasons which need not be given, a different system was utilized. Under their so-called "shadow system" large plants were built at government expense which were intended to provide the reserve capacity over and above the normal peace-time requirements of the aircraft-manufacturing industry. Under this system, the English farmed out to the automotive industry a large part of their proposed expansion. In some cases, I have been told, there were practically no experienced aircraft people connected with the operation of these plants.

All of you are familiar, I believe, with the results which have been achieved in Germany and in England, employing their respective systems. If we are wise we will study those two systems carefully, and select the best features of each. The technique of airplane manufacture is considerably different from that of automotive practice or of any other industry. Actual construction and assembly of airplanes must be left in the hands of those with long experience in the field. Those parts requiring machine-tool operations may very well be turned over to the automotive industry.

Training the personnel for this expanding industry will not be a simple problem. At present there are less than 30,000 men employed in this country in the construction of airplanes. I have been told that one plant in Germany employs more than 65,000 men.

Official Photograph, U. S. Army Air Corps

CURTISS P-6E AIRPLANES OF THE 17TH PURSUIT SQUADRON—A TYPE THE MONOPLANE IS SUPPLANTING

School systems have already been started in some of our factories. This procedure consists primarily of a system of selection followed by job training where a man is taught efficiently to perform one job. Employing this system, many very satisfactory workmen who had no previous experience have been drawn into the aircraft industry.

THE bottle neck appears to be the limited supply of trained supervisory personnel, shop superintendents, assistant superintendents, foremen, and shop lead men—the sergeants and corporals of industry. Our training programs must provide for the needed quantities for this supervisory work. This type of personnel cannot be procured overnight. One of our leading manufacturers has estimated that it would require a year to expand his force 2½ times.

Machine tools required for aircraft and engine manufacture in quantity would almost certainly constitute a serious bottle neck in any expansion for a national emergency. We must prepare now to provide the machine tools which will be required. The construction of additional factory space for airplane manufacture does not, in my opinion, constitute a serious problem, particularly if we first make use of existing factories now operating far below economical capacity.

Official Photograph, U. S. Army Air Corps

THE SEVERSKY P-35—LATEST TYPE ARMY PURSUIT AIRPLANE

There is not the slightest question but that our existing industry can reasonably expand and without undue inflation produce the airplanes we require for our new program, or that present industry could not possibly meet the requirements if we should go on a war footing. This brings up the question of the provision of an initial war reserve.

Combat types, if built in large quantities would within 8 or 10 years be obsoleted by later developments. Aircraft development is not yet sufficiently stabilized to make it economical to provide large war reserves of military combat airplanes. We can, however, provide a considerable war reserve of those types which can be frozen over a period of years. Training planes are in this class. Fortunately large long-range bombardment aircraft have a slower rate of obsolescence than do fighter types. It is safer, therefore, for us to provide a larger reserve of bombardment planes. Generally speaking, however, under our present plan, we propose to provide a war reserve only in training types and an operating and depot reserve only of the combat types.

Another important means of accelerating production in the early phases of an emergency would be the creation of stock reserves of raw materials which would be immediately available for shipment to manufacturing establishments.

I HAVE realized that the primary consideration of an organization such as yours lies in the problems of industry and I have therefore devoted the major portion of my time today to a discussion of our problems in this field. I am convinced, however, that every present-day American is vitally concerned not only with the economic but with the political field—particularly the international political field. I want, therefore, to leave these additional thoughts with you.

There is at present, among all the leading nations of the world, a tremendous emphasis on air power as an instrument in international negotiations. Every well-informed citizen must be familiar with the important part which a powerful air force played in the negotiations at Munich.

The possession by a nation of a strong air force is, I am firmly convinced, the best guarantee for peace. An English writer, Mr. J. M. Spate, in his book "Air Power in the Next War," put it this way: "History is full of the wars that were never fought. Air power will probably add to their number. Is it not conceivable that we are on the threshold of an era in which wars will be won before they are fought?"

Any nation which is hopelessly outclassed in military strength has in the past and will in the future accept such terms as the nation with the overwhelming military power is pleased to dictate. It is now definite and positive that air power has come to join sea power and armies to form the triumvirate which totals military might.

Here in the West, I am told, in the pioneering days when the bad men became 2-gun men, the vigilantes and the good men began to carry two guns also. When the bad men learned to shoot from the hip, the honest citizen and the peace officer developed this facility. It is quite apparent, I believe, that right now, internationally, we are living in a 2-gun world. It behooves our nation, peace-loving though it may be, like the vigilantes of old, to arm and train and equip to meet the new threat. In that way only can our method of living and our civilization hope to survive.

Artillery Ammunition Production

An Ordnance Problem and the Frankford Arsenal Answer

By Lieut. Col. Levin H. Campbell, Jr.*

ON NOVEMBER 9, 1938, I was privileged to deliver an informal address before a distinguished gathering of members of the combined engineering and industrial societies of Philadelphia under the sponsorship of the local chapter of the American Society of Mechanical Engineers.

The subject of my talk was "Manufacturing Problems of Artillery Ammunition." The editor of ARMY ORDNANCE, who heard my remarks, prevailed upon me to commit their general tenor to writing. This I have done in the hope that readers of this journal and industry generally will know again that *production* is always a great objective of any Ordnance ammunition program worthy of the name. Having due regard to quality of product, in time of major war our greatest task will be production, production—and yet more production!

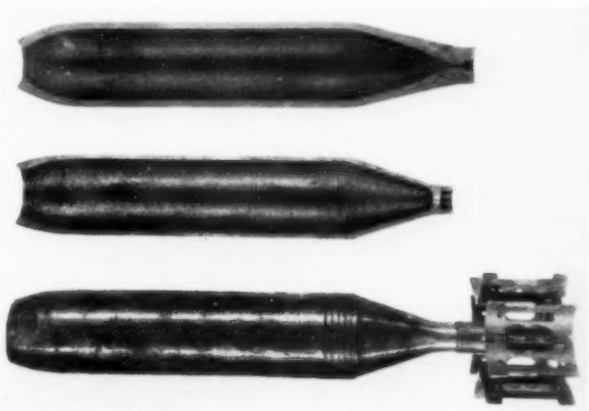

FIG. 1. TRENCH MORTAR TUBE SHELL, 81-MM., M45

The following paragraphs are put down in proof of two facts: 1. The Ordnance Department today is increasingly conscious of the importance of production engineering as applied to artillery ammunition. 2. A limited effort is being made at the Frankford Arsenal in this direction. This latter is good evidence that production methods are not being lost sight of. Best of all, perhaps, it is proof that we of Ordnance are becoming *production-minded*. I hope readers who are in a position to aid us or who may become better equipped to do their war-time defense jobs will read with a sympathetic eye and write any comments they may have with a charitable hand. For our ammunition-production program at Frankford is along the path of the pioneer, and to the pioneer, sympathy and charity are as welcome as they are helpful. I submit the following in furtherance of this spirit.

In what I shall say here I have no idea of going into details, and equally, I have no idea of boring the reader with dimensions, tolerances, chemical composition, and other minutiæ. But there is one thread I am going to try to weave through the pattern of this discussion, and if I leave with you the one thought of the importance of production from the Ordnance standpoint, I will have accomplished my purpose.

When war comes, the Ordnance Department automatically is charged with a production problem of immense proportion. In the battle of the Somme, of seven days' duration, the British Army alone required 4,000,000 rounds of ammunition, and at the battle of St. Mihiel, our Army alone in four days fired 1,093,217 rounds of artillery ammunition. Therefore, in time of peace, we must be ready for an enormous expansion. Our peace-time preparation must consist, above all else, in adapting our drawings and specifications to a basis of production. It is entirely secondary whether we ship ammunition or other Ordnance items on schedule in time of peace. It is of enormous moment, however, that we cause our drawings and specifications to be developed to adapt our manufacture to mass-scale production. No greater contribution to the success of the Ordnance responsibility in war can be made by its arsenals, or by any other of its agencies, than to prepare production drawings in time of peace of the various items which we manufacture. We must not enter a possible future emergency and hope to reach early production from engineering drawings—World War experience should be too fresh in our minds for that.

I PROPOSE now to cite a few object lessons in proof of what can be done in this regard. Fig. 4 shows our shell shop at Frankford Arsenal. Here we see a small production unit adapted to turn out a few shell per 8-hour day. It is the last word of the present day and hour in the production of shell. One of my friends was in my office recently with a particular design of lathe. In the course of conversation he said he had just returned from a foreign country where they are turning a certain caliber of shell in, so he said, something less than three minutes. I asked, "Why the delay?"

Of course, our set-up at the Frankford Arsenal is a very small one, with a limited capacity. We have the hope, however, that funds will become available from time to time to replace machines as those of better design with higher output are offered by the industry. This is the policy and practice followed by any large production factory which is dependent upon a high output with a narrow margin of profit. Our arsenals should be enabled to follow the same practice. Such an expenditure per year to keep our small shell manufacturing set-up modern will be relatively low, if such is made every year. Unfortunately, it often happens that no funds are available for a long period of years, and after such a period a really sizable job confronts the one who tries to modernize. Not only is the job sizable, but the funds required, having grown to large figures, represent a real obstacle.

The Ordnance Department is doing a splendid job with

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the limited funds it has available in time of peace. But the fact that funds are usually so limited often makes us lose sight of our main function in time of war. That function is *production*. Production must, of course, occur before the supply functions of the Department can be undertaken, and it is my firm belief that we should pay an equal amount of attention to production methods, as we necessarily do to design and development of Ordnance equipment.

FIG. 2. THREE-INCH ANTIAIRCRAFT TUBE SHELL

Let me cite our 81-mm. M45, trench-mortar shell (Fig. 1) as a case in point. This is a shell susceptible of quantity production. It is made of commercial seamless steel tubing. We think it can be made equally as well of welded tubing. The rear end of the shell is closed in by hot swaging and the front end by a cupping die set in a crank press. This method of manufacture stands in marked contrast to the method previously used, whereby a forging of an average weight of 42 pounds was purchased, although the weight of the completed shell body produced therefrom is 7.71 pounds. The weight of the tubing section is 17.25 pounds.

The terrific amount of unnecessary labor in making the steel, transporting it, and cutting off the excess, needs but little comment when we are speaking of quantities to be met with in time of war. The maximum machine-tool load is correspondingly reduced. And make no mistake, the machine-tool load is one of the knottiest problems confronting the Ordnance Department for its initial plunge into production in time of emergency. Anything we can do to *lessen* the machine-tool requirement by simplifying our product is surely a great step forward in war planning.

THE forging shown in Fig. 3 is of the same diameter of mortar shell. But it is made on the dies shown in conjunction with an upsetter. You will note from the dies, the first pass is a bumper, or kick-up, operation. The next three are dies and punches, and the last merely a cupping die for putting the ogive on the shell. This shell was formerly made from an SAE 1050 steel forging, the average weight of which is 18 pounds. The finished shell weighs an average of 3.84 pounds.

Thus again, we find an excess of ore to be mined, steel to be made, transported and machined unnecessarily. Therefore, to make this shell by means of an upsetter at an average weight of 7.88 pounds, is, we believe, a step toward production. It is quite true that there are not many upsetters in this country; therefore, we doubt that we have arrived at the real solution of this particular shell problem for quantity production. But the upsetter may be considered as a means of augmenting the forgings produced in the conventional manner. In future, all forgings should be of the finish forged cavity type, and should be made of a free-machining steel. These steels contain the necessary physical properties without heat treatment and their use is indicated.

In the simplification of any problem of ammunition production, we also must consider the grade of steel to be employed to meet the ends desired. Above all, we must be sure the steel we are using has the necessary physical properties to prevent the shell from upsetting or prematuring in the gun, with resultant damage to both gun and crew. The enemy, after all, is the target and not our own people. In the M45 mortar shell made from tubing as described above, we find we can secure ample physical properties by the use of a heat-treated .35 carbon steel. For machinability, lead-bearing heat-treated or cold-drawn nonheat-treated steel is preferable. Obviously, it is easier to machine this steel than it is to machine .50 carbon steel from which the shell previously were made. In the case of the 81-mm. M43 mortar shell, we find that the physical characteristics required are very modest and are more than met by the use of a free-cutting, high-sulphur, or lead-bearing steel. Obviously, the machinability of this steel is much greater than that of WD-1050 steel, which formerly was used in the shell. If the machinability is greater, the machine-tool load is reduced correspondingly, to say nothing of the number of operators required in time of mass production. Operators thus are released for some other useful effort.

FROM the production standpoint, the 3-inch antiaircraft tube shell (Fig. 2) offers great possibilities. The finished body weight of this shell is 9.28 pounds. The weight of the conventional forging amounts to 23 pounds, compared with 13.88 pounds for the upsetter forging and 12 pounds for the tubing section. The weight of the tubing section, however, does not include the base plug. The shell, as will be noticed, is made from seamless tubing which has the necessary physical properties. The tubing is cut to length, a turn is made for concentricity, a thread is put in at either end—one for the fuze, the other for the base plug shown at the left of the illustration. This latter is screwed in and faced off. The thread seam is covered with the steel disk shown at the right of the illustration, which is spot-welded into place.

FIG. 3. TRENCH MORTAR UPSETTER SHELL, 81-MM., M43

The shell is then banded and finished. This shell, requiring only lathes and a crank press for banding, to our mind,

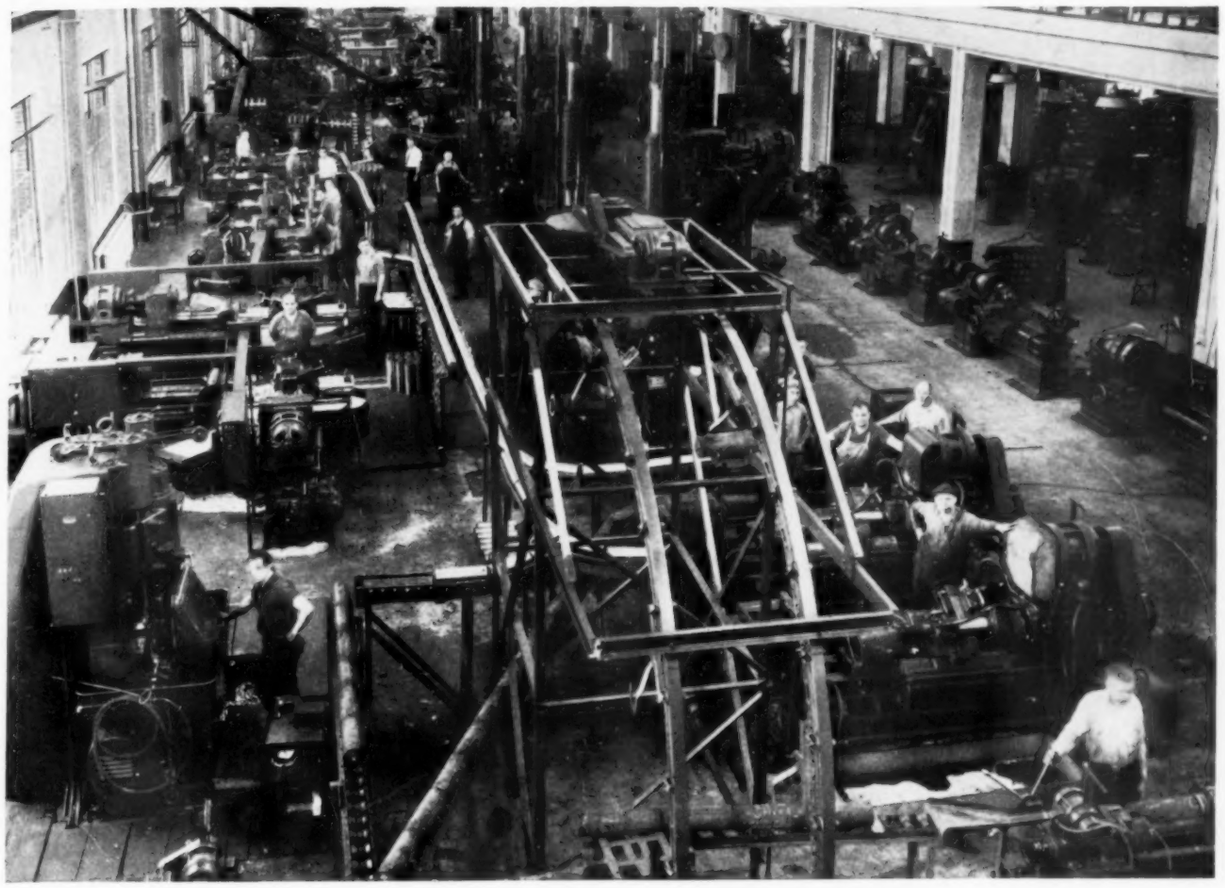

FIG. 4. STRAIGHT-LINE SHELL-PRODUCTION SHOP AT FRANKFORD ARSENAL

has this tremendous advantage—it could be produced in a great number of machine shops, large and small, throughout the country. The shell does not fragment as well as does the one with an integral base, but by using this design of shell, we soon could have a supply of ammunition which could be used effectively while waiting for the better type to be produced. The production of shell forgings of integral type, however, is indeed a choke point of shell production in time of emergency.

THUS, we believe a very real step has been taken in adopting the tube shell as an alternate for production. It is most likely that it will be the first shell to be made in quantity, as the production facilities for seamless tubing in this country are almost unlimited. This shell has a straight cavity, and as such, boring does not enter into the picture. Boring, incidentally, is one of the most difficult operations for mass production, due, principally, to the fact that to bore in quantity satisfactorily, special machines must be made. Our Ordnance Department, as well as foreign armies, are fast getting away from boring of shell.

One of the very attractive features of the seamless steel-tube shell, is the fact that the necessary physical characteristics may be had in the steel in the drawing operation, so that it is not required to heat treat the shell body. In time of war, another one of the serious choke points is heat treating. To prevent a differential of hardening within the shell, it is necessary to be sure that simultaneous inside and outside quench is had. This can be done positively only by using nozzles which force oil under high pressure and great volume into the interior cavity. The furnaces are, of course, of special design, and there is little or no demand for them in this country in time of peace. They must be built after the beginning of the emergency, and thus another source of delay is met with in reaching production if we are required to use a steel which must be heat-treated to secure the necessary physical properties. The "X" steels require no heat treatment. If we can eliminate heat treatment from any shell, we have indeed made a step forward in the matter of reaching production in a minimum of time and with a very minimum of effort.

THE 3-inch antiaircraft shell as made on the upsetter is shown in Fig. 5. The comparative weight of the forgings made by this method with those by other methods has been given above. Substantially, the same remarks apply to this manufacture as were made in the case of the 81-mm. shell made on the upsetter. In our experience, one very important thing was learned early; namely, we must have a minimum of scale if we are to produce forgings on an upsetter successfully. We have, therefore, installed a system of induction heating of the bars used in connection with the production of shell forgings on the upsetter. This system, being very quick in its heat application, gives little opportunity for the scale to form and has contributed in no small part, we believe, to the successful production of forgings.

It should be made perfectly plain that the production of shell on an upsetter, while a thoroughly practicable method, can be considered for war time merely as a minor augmentation of shell-forging supply. This is due to the fact that there are relatively few upsetters installed, and such as are available will be used for other work in connection with the equipping of armed forces. The so-called conventional method of shell forging is, and apparently this method will remain, our sole major source of shell-forging production.

In our effort to further simplify our production, we have, within the past two years, done a good deal of work in connection with free-machining steels, as used so widely in the automotive industry. We also are doing some work with lead-bearing steel—lead to improve machinability and higher manganese for the physical characteristics required. Heat treatment always will remain a very vital problem in time of war, due to the fact that the capacity for heat treating by modern methods is totally inadequate for shell-forging operations. If by the selection of proper steels we can obtain adequate physical properties without the necessity of resorting to heat treatment, we have made a long step forward toward a solution of war-time ammunition production.

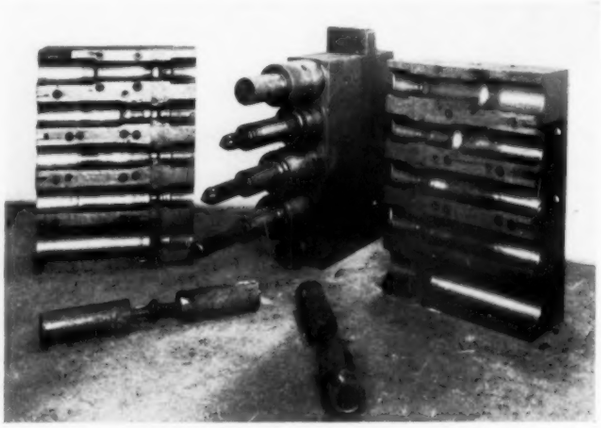

FIG. 5. THREE-INCH ANTIAIRCRAFT UPSETTER SHELL

IN THE matter of cartridge-case production, we are fortunately situated in that there is a practically unlimited supply of brass available. Our small production set-up will be available for inspection and multiplication by private industry in time of war. The latest equipment, and simplest and best methods, together with equipment specifications, tool and die drawings, gages, etc., will be available immediately. Therefore, upon the outbreak of war, the problem remains one of mass production. We, in the Ordnance Department, are constantly striving to improve the technique of manufacture, and to simplify the production with a view to reducing the number of draws and anneals required for the case, to improve the quality of the case as regards hardness of the head and primer seat, and to increase the life of the case, which is usually limited due to season cracking in storage. We have succeeded in greatly increasing the drawing speeds of feet per minute, and by the use of carbide dies, the load on the tool room in die maintenance and supply can be and has been reduced very markedly.

Another problem remaining for solution is that of mass production of the mechanical time fuze. Our production unit at the arsenal, while very adequate for the small number of fuzes required in time of peace, represents but a small fraction of the war-time load to be carried. We are, therefore, engaged, coincidentally with manufacture, in research and development, looking toward constant simplification of the fuze to make it more readily manufacturable in time of emergency.

The problem of artillery primer mass production is one which will offer a minimum of difficulties in time of war. Our primers are susceptible of being produced on small automatic screw machines, of which, of course, there is a large capacity in the country. Assembly is a relatively simple operation.

At the Frankford Arsenal we have installed, within the past two years, the most modern machinery and equipment for small-scale production of various caliber artillery shell, cartridge cases, primers, and mechanical time fuzes. Our object in this was not to equip the arsenal for large-scale production, but rather to make of it a laboratory of production. This laboratory today represents the best of the machine-tool and equipment builders' arts. With the rapid developments occurring in the machine-tool art, however, our small production lines should be considered merely as loose-leaf ledgers. By this I mean that when a machine becomes obsolescent, or when the industry develops a machine of much greater production capacity, our ledger sheet should be discarded and the new model should replace the machine used in the line today.

UNDERLYING this whole thought is that should war arise the Ordnance Department must of necessity depend upon outside industry for production. While we will call upon industry again as we did in the last war, we surely can give industry more help than was possible at the outbreak of that conflict. We also will have personnel trained in the use of the best machines which the art affords to send to manufacturers' plants to assist them in reaching production. This is of vital importance if we are to save the initial time always required to reach production, be it in ordnance or any other item of military supply. Thus it becomes doubly necessary that these small production lines, which today represent the best that the machine-tool art affords, should be kept ever up to the limit of the art by substituting any improved types of machines as they are made available from time to time.

Those engaged in the design of ordnance equipment of whatsoever nature, and those engaged in its manufacture, should jealously resist any and all attempts to let creep into drawings and specifications, requirements as regards tolerances and materials which impose unnecessary difficulties upon the production engineer. This is, as is so well known, a continuous and unrelenting task for all concerned. Surely there can be no better expenditure of funds than to keep small production lines in step with the art of machine-tool manufacture and to keep specifications always in step with the latest the art affords in materials. Strict application and attention to these cardinal points will save months and months of time in reaching production after M-day. And finally, let me repeat: In time of major war our greatest task will be production, production—and yet more production.

"The Modern Army"

An Analysis of General Maurin's Study of the French Forces

By Lieut. Col. Donald Armstrong*

TWENTY years after the "war to end wars" the most important duty of any nation that hopes to survive the next cataclysm is to improve its defenses. There is no lack of guides to show how this ought to be done. Many of these are self-appointed prophets who speak with specious authority, but some amateur and professional military writers in our own country and abroad have done an extraordinarily good job in pointing the way to a balanced program. None has come to his task with a better right or with greater aptitude for the assignment than the distinguished officer who served successively as Chief of Artillery, Deputy Chief of Staff, major general of the line, Chief of Ordnance, and finally, served twice as Secretary of War.

Of course, it couldn't happen here. But in France, General Maurin has just filled this succession of posts. The harvest of his long and devoted career is garnered in his book on "The Modern Army" ("L'Armée Moderne." By General Maurin. Paris: Ernest Flammarion, Editor. 20 francs.). Unfortunately, there is no English edition of the book.

His reflections on an effective organization and utilization of the land forces and the nation in arms represent his testament. His views deserve careful consideration, bearing in mind that he writes of the French Army and of the defense of France. Our own situation is vastly different, but much can be learned from a consideration of factors that are constants in all systems of national defense.

This review of his book is necessarily one-sided. It is specifically prepared for the special audience of ARMY ORDNANCE. It omits reference to many phases of the study that would be of great interest, but lack of space necessitates concentration on issues that particularly concern the specialist in armament. However, General Maurin emphasizes the importance of matériel throughout his book, and this will be abundantly evident to the reader of these few pages.

General Maurin's thesis may be summarized in a few words: Fire power today is the indisputable master of the battlefield. More than a century ago, Napoleon realized its growing importance. Although early in his career Napoleon hailed the infantry as the "queen of battles," later on he held that "great battles are won by artillery." This power of the bullet and projectile is the result of scientific progress in metallurgy and mechanics, in ballistics, physics, and chemistry. Science, then, has revolutionized the art of killing as well as the art of living. In other words "technical progress is the basis of tactical success."

But new weapons must be properly used by the high command. The first use of gas by the Germans and the defective initial employment of tanks by the British and French armies teach a salutary lesson. "In the complication of modern warfare, a weapon, no matter how novel, or how perfected it may be, should not be used alone. It enters into the combination of weapons, reënforces them, but does not replace them." That is the lesson of the untried weapon for the line. Let the enthusiasts of the tank and the airplane ponder deeply on this reflection.

There is an equally important warning for the technical officer in this question. "However unusual an invention may appear, it should never be rejected; but every effort should be made to anticipate the results that can be expected of it, in examining, however, whether its realization is not too difficult and if quantity production can be hoped for. Modern wars are not won by a few samples."

The employment of fire power by the various arms is studied in detail in the first part of General Maurin's book.

INFANTRY.—In the early stages of the World War, many foot soldiers were convinced that the infantry was the principal combatant arm and that artillery was of decidedly secondary importance. Artillery, they thought, came into action when the infantry with its own resources was unable to gain its objective. This conception caused serious and unnecessary losses, for it failed to comprehend the fundamental characteristics of the two arms.

Infantry attack succeeded only when the rôles of the two arms were reversed. Eventually the infantry was required to adjust itself to the speed of the rolling barrage of artillery fire which moved in its front. This new plan of advance was characterized by Marshal Petain in these words: "Artillery conquers, infantry occupies."

In the modern infantry organization the section consists of three homogeneous groups, each of which numbers fifteen men with a single automatic weapon. The company is the smallest unit in which a weapon other than small arms appears. In France, the company has a 60-mm. mortar whereas a 50-mm. mortar is the weapon used in the German Army.

The armament of the battalion shows how a combination of various kinds of fire is realized. The weapons in the French and German infantry battalions are as follows: *French*—48 automatic rifles, 16 machine guns, three 60-mm. mortars, two 25-mm. guns; *German*—27 light machine guns, 12 heavy machine guns, nine 50-mm. mortars, three 37-mm. guns. The battalion consists of three rifle companies and a company armed with mortars and antitank guns, and is 800 strong. It is the smallest unit assigned an antitank weapon. The regiment normally has three battalions. In addition to the equipment listed above, each regiment has the following supplementary weapons: *French*—two 81-mm. mortars, six 25-mm. guns; *German*—six trench mortars, six 37-mm. guns.

In comparing the infantry armament in the two armies it is clear that that of the German Army is heavier. It is possible that a greater number of these heavier weapons should be assigned to the regimental echelon in order to lighten the task of the battalion commanders. In any case, the regimental echelon must include the personnel and

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equipment for reconnaissance and security; *i.e.*, bicycle and motorcycle scouts. In addition, the regiment must have half-track vehicles, one of which should be equipped to enable the regimental commander to move about on the battlefield. All this armament and equipment, however, must be calculated with the greatest care. In order to lighten the regiments, most of the equipment of this kind must be assigned to the division.

Artillery.—Artillery has profited more than any other arm by the scientific progress which has resulted in increasing effectiveness of projectiles, range, and rapidity of fire. Above all, the effectiveness of the projectile must be examined because it is the true weapon of the artillery. The gun itself is only an intermediary that might some day be replaced by rockets. The perfecting of the projectile is to be sought constantly and no defect in its manufacture, resulting in premature bursts in the bore or less effectiveness at the point of fall, can be tolerated.

The firing of isolated batteries is a useless and dangerous practice. Such firing produces little effect and facilitates hostile sound and flash ranging of the batteries. Combining the principles of mass and surprise, fire is properly used when it is concentrated from a number of batteries.

The function of airplane liaison with the artillery is of vital importance and requires the assignment to the artillery of a certain number of airplanes. The autogyro is particularly adapted to this purpose. The creation of special aviation for the artillery is based on the fundamental principle of organization by which each arm should possess what is indispensable for its own action. Airplanes belonging exclusively to the artillery will economize enormous quantities of ammunition and at the same time leave the air corps free to accomplish its important and distant missions.

No matter how effective a preliminary artillery bombardment may be, there always will be certain hostile armament so well concealed or protected that it will escape. The duty of completing the artillery preparation must, therefore, be assigned to some special type of artillery capable of firing at short range and using direct fire. Since this mission is extremely dangerous for the ordinary type of artillery, the only solution is the utilization of armored, self-propelled guns. This question will be referred to again.

It is obvious that there must be some distribution of functions between the gun and the airplane. To increase the range of guns is costly. If it is sought by modifying the projectile, most frequently it is obtained by decreasing the explosive charge or by using a gun that will have a much shorter life. At the present moment the maximum range of artillery should be limited to about twenty-five kilometers. Greater ranges than this should be obtained by a few guns of very limited use.

Antiaircraft weapons should be provided in various types for particular missions. For low-flying planes up to about 2500 meters, small-caliber guns with a high rate of fire and high muzzle velocity are required. Between 2000 and 4000 meters, guns from 40 to 75 mm. are needed. The improved 75-mm. gun should have a muzzle velocity of about 700 m.s. Above 4000 meters, larger caliber guns of about 90 mm. and even more, are required with which muzzle velocities of 800 to 900 m.s. are obtained.

In order to show the importance of the caliber of the weapon and of muzzle velocity, the time of flight may be calculated for a trajectory required to reach an airplane with a vertical height of 4000 meters and a horizontal range of 3000 meters. The time of flight works out as follows: 75-mm. field gun, 15 seconds; 75-mm. antiaircraft gun, 11 seconds; 90-mm. antiaircraft gun, 8 seconds. These figures suffice to show the superiority of the larger caliber, since the larger projectile will take one-half the time to reach its target compared to the field gun. If the increase in bursting effect is added to this advantage, it is seen that the 90-mm. gun has twelve or fifteen times the probability of hitting the plane as the 75-mm. field gun. This consideration explains the success obtained in Spain with the German 88-mm. antiaircraft gun.

Cavalry.—In Western Europe, the inevitable results of war between nations in arms is the continuous front. Distant cavalry reconnaissance has therefore become unnecessary to orient the commander in chief. The cavalry division with its horse artillery and its own services is accordingly no longer needed. A small regiment of cavalry for each division of infantry suffices to provide a curtain of reconnaissance on the march and to form a tactical mobile reserve behind troops in action.

The cavalry can survive, however, by motorizing itself. In this case the question is, do you want an eye or a fist? a speedy, lightly armored scout car or a combat car? In conclusion, "Cavalry is like one's best suit of clothes—it should be cut to measure."

Aviation.—The fundamental principle of the employment of aviation in war is that "supremacy in the air is today the primary condition for success." There is not the slightest readiness to admit that the air force has become the principal arm of national defense. There should be an air force operating independently with its own special tactics. But another part of the air force must constantly coöperate with the army in the performance of its missions. Unfortunately, further details of the consideration of the very timely and pressing subject, use of aircraft, must be omitted from this review.

Armored Vehicles.—During the campaign in Russia, when there was no forage left for the cavalry, Murat remarked to Napoleon: "Horses have no patriotism." General Maurin points out that the gasoline engine is equally lacking in devotion to its country, because of its demands for skilled personnel, enormous quantities of spare parts and vast repair installations. Motors require daily care and periodical inspections.

Combat vehicles must be able to maneuver on all kinds of terrain and must have adequate armor protection. The former is a question of choosing between multidrive vehicles or the full- or half-track types. The question of armor is theoretically simple, since every vehicle should have armor protection corresponding to its combat function. Cross-country vehicles for the transportation of personnel are sufficiently protected when they have armor protection against long-range rifle fire and shell fragments. The same observation applies to light artillery tractors which necessarily would be stationed in the vicinity of their guns when the artillery is in the firing position. Armor for these vehicles is the more necessary, since tractors are harder to conceal on the battlefield than horses. If it is impossible to protect them against direct hits, at least they should have protection against shell fragments.

Closer to the front, armor becomes of greater importance. This brings us to the consideration of the tank, whose function is to march directly on the enemy for close-range fighting.

Since the introduction of the small-caliber antitank gun as part of the infantry armament, the struggle between gun and armor has recommenced on land. In this struggle, the last word, at least theoretically, should rest with the gun. The stability of its mount insures it unquestioned power. However, the tank has two means of defense that certainly are not negligible. The first is a considerable and effective increase of armor which is feasible if tanks approach twenty tons in weight. The second consists in the multiplication of the number of armored vehicles so that the antitank weapons will be overwhelmed by the numbers opposed to them. In this case, by consenting to certain sacrifices, tanks will traverse the barrier of fire.

The conceptions are evidently opposed to each other because of the high cost of multiplying the number of heavy tanks invulnerable to artillery fire. Veritable land battleships have been built, armed with heavy weapons and with a crew of about twenty men, but such vehicles are difficult to move, especially if rivers have to be crossed. They ought to be used in carefully selected sectors of fortified regions supplementing fixed defenses by a movable fortress. In an offensive, their utilization is difficult not only because of the impossibility of crossing bridges but also because of the appearance of the antitank mine. If a track merely touches such a mine, the tank is immobilized and is immediately subjected to destructive fire from heavy artillery against which it cannot be protected.

The smaller tanks are obviously badly off when opposed by antitank guns and mines. Their advantages consist in their lesser visibility, their relative lightness, their speed, and their number. Therefore, they will provide the principal, if not the exclusive, mass of tanks.

Invulnerability is therefore opposed to invisibility. After preference is given to relatively small tanks, other problems remain to be solved, such as speed, length, and armament. These three considerations eliminate small 1-man tanks contemplated immediately after the World War. Such a tank has slight visibility but on the other hand it is blind itself. The tank crew must be able to see in order to distinguish their objective.

The armament of tanks must consist of all kinds of weapons, including high-velocity guns whose function is the attack of other armored vehicles.

THE question of tank speed is another debatable problem. High speed certainly provides an element of security in facilitating maneuver and in allowing the enemy a very short time to adjust fire, which is an excellent reason for missing the target. But if high speed is advantageous for tanks, it requires powerful motors, increases size of the tanks, and results in too rapid an advance ahead of the infantry moving up in their rear in order to occupy the terrain. This latter disadvantage may be counteracted by towing an armored trailer, occupied by a few men, which easily may be detached from the tank. A new wave of tanks can later pick up this trailer and move it forward. In this way a withdrawal position is constantly made available to tanks together with instantaneous liaison with the infantry.

In considering the question of speed, the design of vehicles with light armament and very light armor may be contemplated in order to secure a high-speed vehicle without excessive weight. Such vehicles, apparently like our scout cars, could render valuable service in every case where they would not have to fear projectiles capable of perforating their thin armor. The use of these motorized machine guns for distant reconnaissance is not very promising. However, they may be of considerable value for obtaining long-range security, since their weapons will cause delay and their armor will protect them pending the arrival of vehicles with heavier armor, and above all, their speed will enable them to escape without serious damage. Moreover, these high-speed motorized machine guns may be of great service when the enemy line is broken. They also serve a useful function in hastening to a break in our own line. Consequently, such vehicles have value ordinarily as a reserve, unless the enemy's service of security is poor, in which case boldness is permitted.

One category of armored vehicles not used in the World War but which today seems absolutely necessary is the armored field gun and observation post. In this case the armor may be light, since the gun is designed to remain in rear of the tanks in order to observe the ground over which they are advancing and in order to engage at once with its fire any weapon which opposes the advance of the tanks. While weapons of this kind might be grouped in a battery for administrative purposes, in the field they must act individually.

It is particularly noteworthy that General Maurin nowhere suggests that the tank has revolutionized warfare. In the defensive, tanks are ideal for counterattacks where the enemy succeeds in piercing our own front but has not yet had time to organize a system of fire. In the attack, tanks must face the serious obstacles of mine fields and of large numbers of antitank guns which will be difficult to locate. In other words, tanks will require the same support in an advance that the infantry demands. The latest antitank devices are as dangerous to tanks as machine guns proved to be in the past to the infantry.

Unfortunately, General Maurin's stimulating comments on organization, the modern battle, supply in the field, and many other phases of military activity must be passed over in silence. The book is unreservedly recommended, however, for its illuminating discussion of every conceivable factor in a military establishment and in a nation in arms. This review must conclude on a note of particular importance to the ordnance expert.

All progress realized in the domain of science must be tested for its possible application to armament, for a scientific development may be exploited by a man capable of realizing its military importance. The great risk that must be avoided is to deny research and discovery the important place they deserve and to depend simply on the using services to define their own needs. Officers must be encouraged to undertake scientific studies and to make of rearmament programs something more than a feeble and timid extrapolation of what already exists. Therefore, an ordnance organization requires commanding officers who are conversant with technical possibilities and who welcome new ideas to the end that they can sift out the good from the bad. The ordnance establishments should have generous facilities for study and investigation, assisted by independent laboratories, which may be those of leading scientists as well as those belonging to private industry.

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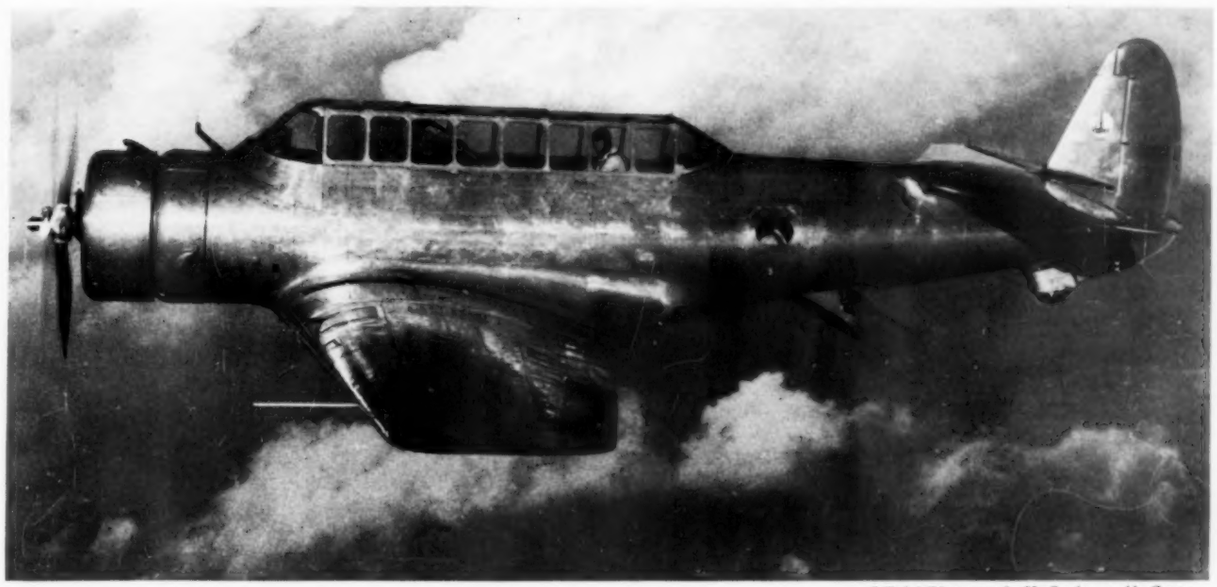
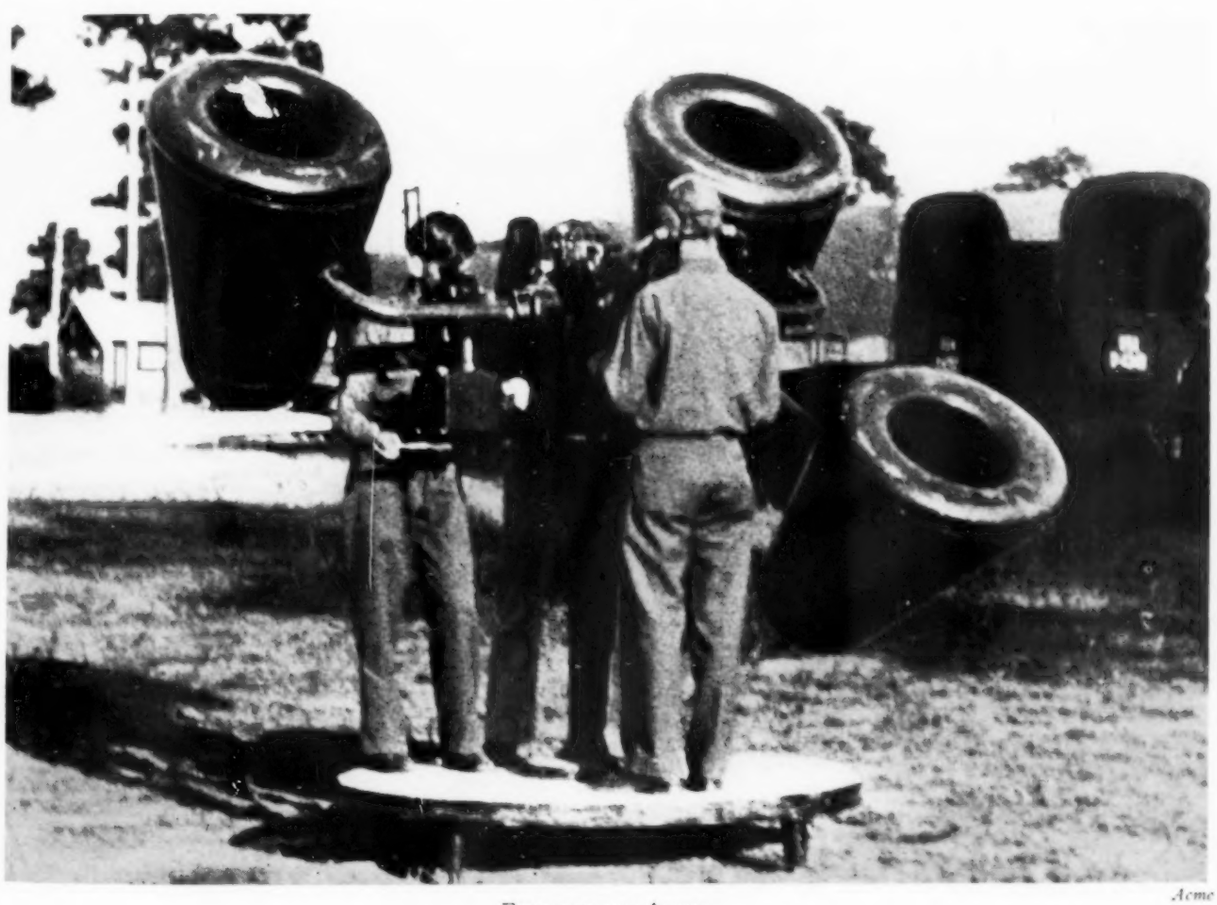


Official Photograph, U. S. Army Air Corps

WINGS FOR THE ARMY

This Vultee 3-place attack airplane is similar to the YA-19, seven of which recently were ordered by the Army Air Corps. Note the tunnel gunner to protect the rear hemisphere.



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In Defense of Antiaircraft

Guns, Not Airplanes, Saved Paris from the Bombers in 1918

By Maj. Thomas R. Phillips*

MOST soldiers know that the last airplane raid on Paris during the World War took place September 16, 1918 and was a total failure. Only three airplanes out of fifty in the raiding squadrons got by the antiaircraft fire of the outer defense of Paris and flew over the city. Two of these three were shot down. But few persons know of the struggle that went on under the surface in France before a rational solution of antiaircraft defense was adopted.

The person principally responsible for the success of the Paris defenses was General Mordacq, military adviser to Prime Minister Clemenceau. While on the Prime Minister's staff, General Mordacq kept a daily journal; an extract translation is given below of all his notes relating to the development of the Paris antiaircraft defenses.

MAY 20, 1918.—While returning to Paris and discussing these different subjects, I returned to the charge concerning another question, very close to my heart, and on which, in spite of all my efforts, I had been unable to make my point. This was the defense of Paris against the "Gothas" [German bombardment airplanes].

For some months Paris had been violently bombarded. The German aviators, with extraordinary courage, came almost with impunity to drop their bombs on the Capital.

For a long time I had known the remedy; I indicated it constantly to M. Clemenceau, but to my great despair, I had not been able to induce him to apply it. There have been so many tales on the subject of this problem that it seems to me essential to tell the history of it. I hope thus to put an end to all the legends, which are very tenancious, very difficult to drive back into the shadows, because they have special interests as a basis.

Paris was not far from being partially destroyed by the Gothas; that is a fact, misunderstood in reality, but which history will register when it is written impartially. The greater part of the men who were closely involved in Government councils in 1917 and 1918 already were absolutely convinced of it. The exact recital of all the attacks executed by the Gothas will show that their fears were not based on any exaggeration.

Many people, and especially political personages, pretend that Paris was saved at the time of the battle of the Marne by their intervention. In the same manner they claim to have prevented the bombing or destruction of certain quarters of Paris. These allegations are absolutely false. If a large part of Paris was not blotted out, it is owed uniquely to the man who at that moment was the head of the Government—M. Clemenceau.

AT the time of his elevation to power (November 1917), the man responsible in all respects for antiaircraft defense was the military governor of Paris, General Dubail. It was his authority by regulations, and his alone, to give all orders and to take all measures for this defense. Since the first slightly serious attack by the Gothas, I had attempted to make the Prime Minister understand this. I did not have much success. He invariably responded, in the course of our long discussions, that it was he who was responsible to Parliament for the defense of the country and, in consequence, for that of Paris also; that it was he who had to furnish explanations to commissions of the Chamber and Senate when they were demanded. I answered that he could not be flour and mill

THIS discussion of antiaircraft is timely, accurate, and convincing—timely because air power is today the object of undivided concern, accurate because the author is well known for his studies of antiaircraft artillery, and convincing because the testimony of General Mordacq, the soldier whose thoughts and experiences are quoted, is factual beyond question. Here is a case where defense against hostile aircraft in time of war is indicated from the record of actual happenings. And that defense, as Major Phillips concludes, is supplied by two agencies: (1) aviation when it is free to attack hostile air power by offensive action; (2) antiaircraft artillery, at the objective, to defend localities and permit the freedom required by defense aviation.

Thus the case for antiaircraft artillery has a physical as well as psychological basis. Trained gunners, augmented by dependable fire control, who can keep their weapons on the target are the very best adjunct to our antiaircraft defense provided the guns are in being in ample quantity. Only when this ground protection is available is the psychological reaction lessened! The Army is on the way toward adequate antiaircraft resources and its effort demands support until the matériel is adequate in quantity and quality to meet any possible military mission.

Major Phillips is noted for the soundness of his defense views. It is to be hoped that his pen will continue to inform his fellow citizens both in the military and secular press on subjects related to his specialty. Now more than ever our country needs clear-thinking, hard-hitting military writers who can guide our progress on sound factual lines. For it is abundantly clear that too many people consider modern war to be mostly a question of hysteria, bombing of noncombatants, and gas masks! It's time we have some straight thinking on the nature of warfare. We are indebted to the author for unearthing at this time a salient part of the air-defense record.—EDITOR.

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Excerpts are from "Le Ministere Clemenceau, Journal d'un Temoin" (1930), by General Mordacq. For permission to use the extensive quotations from General Mordacq's diary the author of this article and the editor of ARMY ORDNANCE make grateful acknowledgement to the publisher of the book, Librairie Plon, 8 Rue Garanciere, Paris.

at the same time, and in consequence he was obliged to delegate some of his duties. "In this case," he said, "it will be the Under Secretary of State for Aviation." In my turn, I replied: "That would be very regrettable, for the Under Secretary and his entourage have ideas concerning defense against air attack that I consider false. And certainly they will not fail to give orders to the military governor of Paris, which is, again, not one of their functions." Seeing that M. Clemenceau's ideas on this subject were fixed, I did not insist—as always in similar cases, planning to resume the discussion later.

However, thanks to the daily contact I had with the military governor of Paris, I intimated to him that he should not abdicate, and consequently he energetically should maintain his prerogatives for the defense of Paris against air attack. Knowing, on the other hand, that at the Undersecretariat of Aviation they had decided definitely (and, it should be understood, with the best of intentions) to defend the Capital not only with antiaircraft guns, but more and particularly with airplanes, I made every effort to try to make those interested understand that this method would lead to the worst results. I did not cease repeating that we should proceed from the foundation of experience already acquired; that at the front, antiaircraft guns alone were employed against the Gothas, and consequently, it was only necessary to apply the same method.

At the Undersecretariat of Aviation, they believed that airplanes were capable of giving chase to the Germans during darkness and that they should not renounce this powerful means of action. But all the world knew that pursuit aviation, during darkness, could do nothing. We did not have pilots able to handle the machines in darkness, and furthermore, there absolutely was no appropriate matériel.

Unfortunately, there were a large number of aviators in Paris who found life in the big city more agreeable than that of the front and who exerted strong pressure to maintain some reason to be kept in the Capital. I knew it very well. I felt that it was necessary to say all this in the interests of the country, but the resistance of the Undersecretariat of Aviation seemed to augment and exert its force in opposition to us. I should add that among the aviators and officers of the antiaircraft defense forces residing in Paris, there were a certain number, who, envisaging solely the general interest, came to me, begging me to fight against this error which could bring catastrophe.

The series of events continued, and the attacks of the Gothas, especially, assumed increasingly disquieting appearances from day to day. I returned to the charge on M. Clemenceau. I knew that with his good sense he finally would see clearly, and that I should obtain, eventually, his backing for this cause, as well as for a number of other questions of military order. In the meantime every effort was made to increase the number of antiaircraft guns around Paris. Every day new ones were installed on the northeast and west fronts and already a start was made on the south. The instruction of the personnel charged with defense against air attack was pushed actively. My idea was to constitute a veritable armor belt all around the city composed of guns which could fire against aircraft—armor as thick as possible, at the very least so thick that no German machine could traverse it.

Some accidents during the attacks of the Gothas rendered me the greatest service. Some French airplanes, pursuing the Gothas, crashed, and several of our aviators were killed or injured. Arguing from these accidents, I showed M. Clemenceau again, that aside from these unfortunate and useless losses, now that we had enough cannon around Paris, the French planes which took off in pursuit of the Gothas prevented our artillerymen from firing. In consequence, they aided the arrival of the enemy birds at their objective. Our cannoneers, busy serving their pieces, were unable to distinguish French from German planes during the night. As soon as they heard the sound of a motor, in doubt, they waited and consequently lost their chance.

IN verification of this, here is what Captain Weiss, a specialist, wrote of night pursuit two years later (November 1920) in an article in the *Revue Militaire Generale* entitled "Notes on the Aërial War":

"Night pursuit never has given results comparable with its expenditures. The English pursuit have a few trophies to their credit. There also are some examples of night combat between our bombers and the enemy pursuit and reciprocally, but all these combats are exceptions. By the end of the war night pursuit was, without doubt, not far from finding a method, but for practical purposes, nothing had been realized. An ingenious idea had been suggested: the division of the sky into zones of pursuit and zones of defense, limited in a precise and rigorous fashion on the map. In the first, the aviation would be launched; in the second the antiaircraft defense corps would empty its cannon in complete tranquillity, since, according to agreement, no French airplane would traverse it. The searchlights would search the two zones to find the enemy planes for the pursuit or the artilleryman.

"The aviation of the entrenched camp of Paris obtained no success with night pursuit. The aviation forces of Le Bourget, charged during the war with the security of the Capital, did not prevent, or even trouble, any raid of the Gothas or dirigibles. Several of our comrades were injured or killed on returning from these excursions, which ended at times with disastrous crashes. I have never heard of authentic aërial combats at night above Paris. The Antiaircraft Defense Corps can thus inscribe in its book of honor all the victories reported by the boasters. If some night pursuit pilot claims that this statement is false, we certainly can say that his performance was never anything but an accidental knockout in the sky."

On the other hand, General Renaud (commander of the Antiaircraft Defense Corps), who had been sent to London early in May to study the antiaircraft defense there, had brought back the following information: Nothing of special interest; the defense against air attack was organized much as that of Paris; the English also, for this defense, used airplanes, but only to cruise outside of London to warn of the approach of German squadrons, or, after their arrival over the Capital, to pursue them. As soon as the Germans arrived over London, only the guns of the antiaircraft defense engaged them.

This was precisely the thesis that I upheld. During this period the attacks of the Gothas redoubled, and this time there were not single planes any longer, but squadrons marching against us. It was necessary to bring the matter to a decision. According to information which came to us from almost all sides, the Germans were laboring intensely to augment the number of their bombardment squadrons. It was certain that they finally would send numerous groups

against Paris and some of these, thanks to the bad organization of our defenses, would reach the center of the city, would concentrate their efforts on one or two sections and would finally set them on fire. Naturally the finest sections would be chosen as targets.

The Session of May 20th with M. Clemenceau.—One day, thus, the 20th of May, assisted by Colonel Gabaud, my chief of staff, who was as thoroughly convinced as I of the necessity of defending Paris solely by cannon, I went to M. Clemenceau and begged him, in the interest of the country and the Capital, to listen to me again. I explained the problem to him anew. Many times, going with him to the sections which the Gothas had made their victims, I had returned to the theory which was dear to me and of which I had attempted to convince him. I felt that he was wavering more and more. This day I finished by winning him to the cause. He gave definite orders to finish with airplanes and every time the German squadrons were signaled, to act against them solely with the antiaircraft guns. As for the squadrons assigned to the defense of Paris, they were sent to the aviation field near Meaux with the mission: (1) To reconnoiter continually, and especially in the evening, between the front and Paris in order to signal, if possible, the arrival of German bombardment squadrons; (2) To attack these squadrons when, *after having bombed Paris,* they were returning to their landing fields.

It was the best means, on the one hand, to prevent them from interfering with the fire of the Paris antiaircraft guns, and on the other, of utilizing them for the defense of Paris.

During these few months, thanks to Colonel Sacconey, the organization of the armor of which I have spoken previously had made great progress. The methods of fire had been simplified, and information stations, warning posts intended to signal, minute by minute, the movement of the enemy squadrons, had been installed with excellent facilities. Later, thanks to German documents and to French documents at the Ministry of War, we learned the strength of the German squadrons which were launched on the Capital during the last months of the war and especially at the time when Paris was no longer defended except with guns. It is astonishing to note the small percentage of airplanes which were able to fly over the city and drop their bombs, while the mass of the squadrons, under the fire of our guns, turned about or turned aside. Now our gunners have the documents which proved this fact clearly, but the German statistics are still more suggestive.

A Radical Decision, May 21st.—The next day, the 21st of May, I admit that I exploited the situation a little. Seeing that the Prime Minister was now completely won over to our doctrine, I profited from it to open up another question of antiaircraft defense which also had been in suspense. . . .

Following the organization of numerous antiaircraft warning posts around Paris and even in the city, and in consequence of an order given long before (November 1917) to fire as long as possible on German planes as soon as they were signaled, a certain number of shells had fallen on Paris and wounded a number of persons. This resulted in numerous and violent complaints to the deputies and municipal councilors of Paris. What to do? These incidents were evidently very unfortunate, but we had only one means to prevent Paris from being burned: that was to fire vigorously on the enemy squadrons as soon as they appeared. As far as the antiaircraft defenses north of the city were concerned, there was little difficulty: they had time to fire on their adversaries before these were able to fly over the city. But for those located to the east, west, and south, the chances of firing were presented when the enemy was just over the city, and they had to open fire when they could. As far as I was concerned, I had always upheld the following thesis: If the inhabitants would conform to instructions of the military authorities and remain in their houses during the alert, they would not need to fear accidents—an obvious truth.

Until then, M. Clemenceau had hesitated to give definite orders to fire regardless. He consented on this day, ranging himself completely on my side. I had General Renaud, chief of the antiaircraft defense, called at once and transmitted the orders of the Prime Minister to him. One can say, that since this moment, and following the decisions reached the day before, the antiaircraft defense of Paris was assured under satisfactory conditions. The events showed it clearly.

Airplane Raid of May 21st.—May 21st, the Germans made another airplane raid on Paris. The official communique told of it in the following terms:

"Some enemy airplanes having been signaled by our warning posts flying toward Paris, the alarm was given at 10:40 P. M. The different means of defense went into action. Violent barrage fires were opened and our squadrons took the air. The enemy dropped a number of bombs on diverse localities on the outskirts of the city. Some victims and material damage were reported. No enemy planes were able to reach Paris. One of them, hit by our antiaircraft artillery, fell in flames north of the Capital. The end of the alert was sounded at 1:00 A. M."

The Germans, this time, had come in force. According to the warning posts, fifteen or sixteen flights had participated in the raid. The success of our antiaircraft defenses was complete: not a single plane had been able to reach Paris.

The Raid of May 22nd.—There was still another raid during the night of May 22nd-23rd. Of forty enemy planes which attempted to fly over Paris, but a single one succeeded. They had few victims and these were almost all on the outskirts. As for the Parisians who were injured, they brought it on themselves. They were those who in place of remaining under cover did not wish to miss "any such show" and most of them were injured by our own shell fragments.

The antiaircraft defenses continued to function under favorable conditions. As soon as the raiders were signaled, the searchlights opened up, and fire commenced as soon as the enemy planes came into the rays. More frequently, however, they betrayed themselves by the sound of their motors. Our own aircraft, stationed outside of Paris and at Meaux, left their hangars to cut the retreat of the enemy.

May 27th.—This same day, or rather during the night following this day, the Germans completed their bombardment of the day (Big Bertha) by an airplane raid, which happily had slight results. However they constantly augmented the strength of their squadrons, and from this time on, they always tried to fly over Paris with fifty or sixty planes. The 29th and 30th they renewed their attempts without any greater success.

June 4th.—This evening, to complete the day, we had an airplane raid, which was, happily, quickly stopped; at this time, as we have seen, thanks to M. Clemenceau, Paris was defended with gunfire and no longer by airplanes.

PARIS IS BOMBARDED WITHOUT INTERMISSION (BERTHA AND GOTHAS).—Following the 27th of May, bombardments by Bertha and the Gothas continued almost without intermission, but happily without many victims. The German aviators executed new raids during the nights of May 31st and June 1st, 3rd, 6th, 15th, 26th and 27th. During the latter, the enemy, weary of throwing themselves against the formidable barrage of fire constituted north of Paris, continually augmenting the number of their flights, attempted to reach it from the east, the west and the south. Each time they found the number of antiaircraft guns increased. The armor around the Capital now existed in a continuous belt. Searchlights and balloon barrages became more and more numerous. The defense of Paris was finally well organized.

Nevertheless, there were some victims. The Parisians, confident in the new measures of protection, ended by neglecting all precautions. The alert sounded in vain. They remained in the streets, noses pointing skyward, deeply interested in the spectacle, always new, which the antiaircraft fires afforded them. This was the cause of the communique of noon, June 28th: "The number of victims of the bombardment last night is known exactly: 11 killed, 14 wounded. The greater part of the persons hit were in the streets. The Government wishes to reassert that on such occasions it is indispensable to seek shelter. The public should not neglect any of the measures of precaution provided. They alone will permit the diminution of the dangers of bombardment."

There also were alerts on the nights of the 28th of June and the 1st and 2nd of July. But, as before, the German aviators were not able to fly over Paris and instead dropped their bombs on the outskirts where the number of victims was extremely limited.

OUR adversaries, since the end of March, had recognized that their bombardment of French cities was far from giving them the moral results on which they had counted. This is known today, thanks to the publication of General Von Hoepener's book, "Germany and the Air War". He states:

"March 21, 1918, at the precise moment when every resource was stretched to the extreme, General Headquarters was advised that the Reichstag was going to pass a motion on the possibility of an agreement relative to aërial bombardments and had received an order to inform the Government of their personal opinion on this question. The pretext involved was the painful situation of the population of the south and southwest of the Empire, which found itself exposed to enemy bombardment, and demanded that they be aided instantly. General Headquarters responded that the trials of the German cities could not be compared to those which the French cities had supported for three years with remarkable strength of spirit, and that, under these conditions, it would be proper to announce to the Reichstag that since the adverse governments had made no concrete propositions, the German Government should not make known its personal opinion. Actually the enemy (the French) never made an effort in this sense."

I have cited this last sentence especially. It should end the legend according to which the French Government had, following the aërial raids of March 1918, approached the German Government with a view to an agreement relative to these bombardments.

THE END OF THE BOMBARDMENT OF PARIS (SEPTEMBER 16TH).—September 16th represented an important date in the history of the bombardment of Paris. It recalls the last raid executed on the Capital by the German aviators. The enemy squadrons arrived in masses (sixty to eighty planes), but this last effort failed like those preceding. Two or three planes got through the fire of the antiaircraft defenses. We had seven killed and thirty wounded. Two German planes were shot down. After this supreme effort the Germans renounced any further raids.

The total number killed and wounded in the course of all their enterprises against Paris and its outskirts was 869—dead: 115 men, 103 women, 47 children; wounded: 296 men, 250 women, 58 children. More than seven hundred bombs had been dropped. The Berthas had 928 victims: 250 dead and 678 wounded.

THE ANTIAIRCRAFT DEFENSES, SEPTEMBER 20TH.—The defense of Paris against air attack was becoming more perfect daily, thanks to general coöperation. General Renaud, charged with the defense, had gone to work energetically as soon as he received precise directives from the Prime Minister. M. Loucher furnished him all the matériel he needed, except for guns. I followed the question closely; each week I showed the Prime Minister, on a map, the organizations completed the preceding week. On the 20th of September, I was able finally to report that the last absolutely indispensable posts were being completed (in the southern part of Paris) and that, in consequence, the Capital was protected from German aërial attack. Perhaps a few German planes might still get through the defense, and at great risk, but we were protected against any mass attack.

It had taken time to fight the stupid ideas of certain influential personages, who had no competence in these matters, and arrive at last at a logical and practical result, even though the same thing had been accomplished long since at the front.

IN MY opinion, the erroneous conception of antiaircraft defense against which General Mordacq fought so vigorously, still prevails in the United States. But where General Mordacq had one man to convince of the error of his conceptions, we have a nation to educate.

The bombardment of Paris started slowly and gradually increased in scope. Time was given to develop defensive measures before grave disaster intervened. In any future war, the bombing forces are waiting and ready for massive operations immediately. In the United States, at least, the defenses are not prepared.

Increased speed of bombers makes interception by defensive pursuit, more than ever, exceedingly difficult. Aviation supplies the best of all possible antiaircraft defense when it is free to destroy the hostile air force by offensive action. It can be given this freedom only when the defense of localities is undertaken by the antiaircraft artillery. The only effective defense that can be furnished *at the objectives* of air attack is that supplied by antiaircraft agencies. Realization of this not only will increase the effectiveness of protection, but will allow our own air force to operate in accordance with its special capabilities.

EDITOR'S NOTE.—Readers, we are confident, will join their thanks with those of the author to the publisher of General Mordacq's book, Librairie Plon, Paris, for permission to republish here the copious extracts from that volume. The book, in French edition only, was originally published in 1930.

The Treeby Chain Gun

A Very Early Adaptation of the Belt Feed Mechanism

By S. Basil Haw*

CONCERNING Thomas Wright Gardener Treeby, of Westbourne Square, London, history has but little to relate. The records of the British Patent Office make no mention of his having followed any specific occupation, but since four out of the ten patents granted to him between 1855-1862 dealt with civil-engineering matters, it seems likely that he had some connection with the latter profession. He was not a member of the gun trade, but obviously was deeply interested in the subject of firearms, for out of the remaining six patents, the last three covered between them such widely diverse items as a capping breechloader rifle, a breech-loading cannon, a special form of automatic target, and a method of ordnance construction. The first three were concerned with details of an ingenious multishot repeating rifle—the so-called "Treeby chain gun"—which forms the subject of this article and on which his claim to fame chiefly rests. It was certainly one of the most curious of the many new weapons patented in England during the 1850's—a decade notable for developments in firearms technique.

Courtesy of F. Russell, Esq., London

THE TREEBY CHAIN GUN, PATENTED 1855

Treeby appears to have taken the ordinary revolving rifle of the period as the basis of his invention, but his own arm differed from the latter type in one outstanding feature—it was fitted, in place of the usual cylinder, with a series of separate steel chambers linked together to form an endless band or chain which moved through the breech, somewhat in the manner of the belt of a modern machine gun. The movement of these chambers was effected quite simply by having them pass over a pair of cogged pulleys mounted on a spindle which was rotated and locked by the action of cocking the hammer—the operating mechanism being of the single-action type common in revolvers of the period.

An important problem which confronted him from the outset was that of securing a gas-tight joint between the forward end of the chambers and the rear end of the barrel. The simplest way of achieving this was to devise some means by which the two might be pressed tightly together at the moment of discharge and then separated sufficiently to allow a fresh chamber to be moved into position. The question of flash leakage between chamber and barrel already had been tackled in the case of two London-made revolvers—the "Collier" (1818) and the "Lang" (1850)—by the use of a backward and forward movement of the cylinder, but this method no doubt presented certain mechanical difficulties in the case of Treeby's gun, and he employed in its place the reverse process of leaving the chambers fixed and making the barrel movable.

The barrel was connected to the frame of the gun by a tapered steel sleeve. The forward (and narrower) end of this sleeve screwed onto a series of raised threads on the barrel's surface, about three inches from its rear end, the other end onto a threaded collar located on the forward edge of the gun's frame in line with the axis of the chamber in position. Rotation of this sleeve by means of a bolt handle attached to it, caused either a forward or backward movement of the barrel. The natural tendency of the latter to rotate on its own axis during the process was checked by fitting it with a small lug which engaged with a slot cut lengthway through the frame collar onto which the sleeve screwed. Considerable ingenuity was displayed in the design of this barrel-attachment system, for with it a unidirectional movement of the sleeve in relation to the frame of the gun and of the barrel in relation to the sleeve occurred simultaneously. Only about a quarter turn of the sleeve was needed to move the barrel forward sufficiently to free the discharged chamber. The action of cocking the hammer brought a fresh load into position, a quarter turn of the sleeve in the reverse direction locked barrel and chamber together again—and the gun was ready for another shot.

TREEBY was granted his first patent for the "chain gun" (British, No. 1552) on July 11, 1855. Both the belt of chambers and the barrel-shifting mechanism were embodied in the specification, and the drawings which accompanied it showed the possible application of the system, not only to rifles, but to pistols and cannon as well. The design of the rifle itself included the provision of a link action connecting

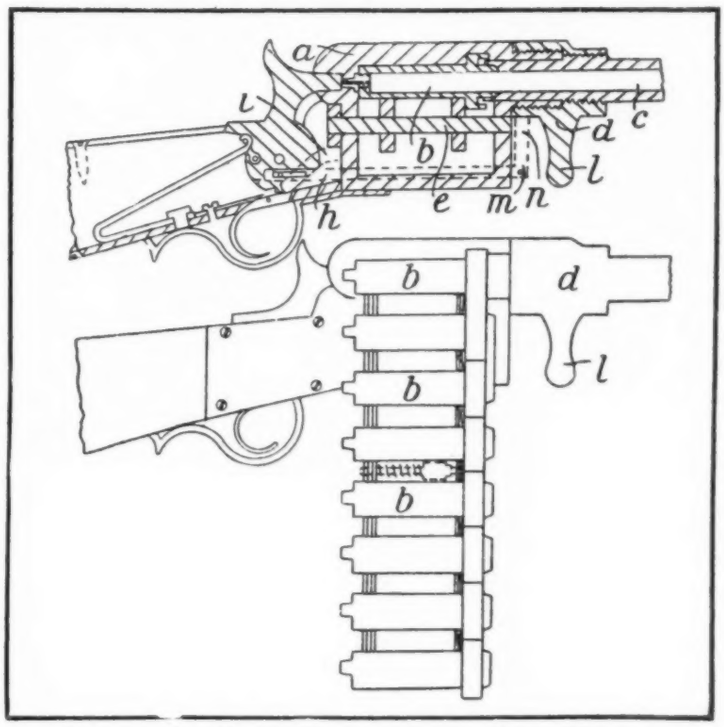
*Private collector and student of antique arms; Green Heys, Sidcup, Kent, England.

the barrel to the toe of the hammer, the idea being that the operation of the sleeve handle to move the barrel forward also should cock the hammer and move a fresh chamber into position. Treeby, however, appears to have found this device too complicated for practical purposes and to have abandoned it in favor of the simpler form of design in which two distinct motions were required. Another distinctive feature of his original patent was the fitting of a rubber ring on the mouth of each chamber to act as a further gas check. This also appears to have proved unsatisfactory and was replaced by the method of tapering the forward ends of the chambers to fit into a corresponding expansion of the breech end of the barrel.

The few widely scattered specimens of the Treeby gun which have survived to the present day show, no doubt, small differences of individual design, but the one which illustrates this article may be taken as more or less standard. It bears the London view and proof marks on both barrel and chambers, measures 3 feet, 3 inches over all, is fitted with a belt of 14 chambers and weighs 10½ pounds. The barrel itself is fractionally over 20 inches in length, is rifled with 5 grooves and has a caliber of .50 of an inch. The chambers are 2¼ inches long, slightly tapered at their forward ends and equipped with center-fire nipples. The rear face of each chamber is hollowed out and the nipple screwed into the base of this recess in such a manner that its head is fully protected from the risk of striking against the frame when in motion. This system of mounting also serves to obviate the risk of flash leakage between the bases of adjoining chambers, since the one in the firing position has its rear end firmly clamped against the face of the frame and the nipple is thus fully inclosed. Detonation is effected by means of a short sliding bolt which passes through the rear end of the frame and is pivoted to the hammer. The latter is, incidentally, shown at half cock in the illustration. The small rectangular plate on the front of the frame (discernible between the front of the chambers and the sleeve handle) probably was provided as a fulcrum for the finger tips of the user's left hand, to facilitate the firm closing home of the barrel.

The framework of the gun itself is constructed more or less on the general lines of the "solid-frame" revolver of the period and has a wide, curved-section top strap. The geared spindle over which the belt of chambers passes occupies much the same position as the cylinder spindle of the latter arm. The lower end of the belt passes over a second pair of pulleys (free-running) whose spindle is mounted on a couple of short steel supports bolted to the lower edge of the frame. These bear obvious signs of having been fitted subsequent to the gun's manufacture, and it is interesting to note that in Treeby's original design only one set of pulleys was fitted. He evidently found, however, that the free-swinging belt of chambers was inconvenient and added the secondary pair in order to keep it in place, covering this feature in his third patent (British, No. 1306, June 9, 1858).

The gun is not fitted with any form of rammer, though the pistol illustrated in the original patent specification is shown with one attached. It is somewhat similar in appearance to the 1-piece type used on the first double-action Adams revolver, and mention is made of the alternative method of mounting it on the frame by means of a ball-and-socket joint. Both his second (British, No. 2629, November 21, 1855) and third patents covered details of loading devices—the former including a cap magazine operated automatically by the movement of the rammer, the latter a system which obviated the use of a separate rammer altogether. Unfortunately, both these specifications are unaccompanied by drawings, and the descriptions of the mechanisms are very vaguely worded. It is doubtful if they were put to any practical use. The third patent also included details of a special type of fixed ammunition in the form of a combustible cartridge containing its own cap, designed for use in a belt of chambers whose nipples had been replaced by spring plungers.

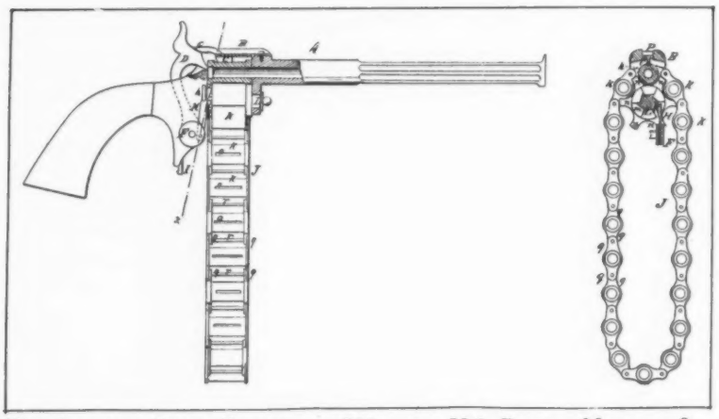


DETAILS OF THE TREEBY GUN, FROM BRITISH PATENT NO. 1552

THERE is no record of Treeby's gun having been offered for sale on the open market, and it certainly never was manufactured in any quantity. The relatively few specimens produced were, in fact, only demonstration models, turned out to his order by some unknown firm of London gunsmiths. It was, of course, a type of arm suitable for military purposes only, and the question of its manufacture therefore was entirely dependent on whether he could succeed in getting the Government to adopt it. In any case, it is more than likely that he had in mind the idea of selling the patent outright in the latter quarter, leaving the matter of production in their hands, rather than of setting up his own plant. It may be taken for granted that he never cherished any hope that it would supplant the existing service rifle, but there was a chance that the Government might find use for it in connection with the specific purpose for which it had

been designed—the defense of fortified positions where the rampart or breastwork would provide a resting place for its barrel to offset the weight of the belt of chambers.

His first patent for the "chain gun" was taken out during the period in which England was involved in the Crimean War, and it is not unlikely that he offered it to the author-



THE JOSSELYN CHAIN REVOLVER, 1866, FROM U.S. PATENT NO. 52,248—AN AMERICAN COUNTERPART OF THE ENGLISH TREEBY

ities at that time. If such was the case, he obviously received no encouragement from them then, and he had to wait four years before they evinced sufficient interest to go into the matter at all. The closing years of the 1850 decade, however, found England in the throes of a serious "French invasion" scare and working perhaps on the general principle that they might as well try anything once, they decided to give it a test. In 1860, Treeby published a small 8-page booklet, whose contents consisted mainly of excerpts from contemporary press opinions on both his "chain gun" and his new capping breechloader rifle. Though it contains, unfortunately, relatively little technical information about the former, it gives, on the other hand, some rather interesting details of the two separate official trials made with it in the summer of 1859—one at some unnamed locality (probably Woolwich), the other at the School of Musketry at Hythe, Kent.

Regarding the first of these, the London *Standard* of June 14, 1859, wrote as follows:

"On Friday last, the experiments were made upon both the 'new chain gun' and the 'breech-loading rifle' and we have no hesitation in affirming, from ocular demonstration, and what is more, the opinions expressed by the officers and other gentlemen then present, that the success achieved was very great. Among those present we observed the Earl of Harrington, General Sir Scudamore Steel, K.C.B., General Downing, Sir Robert Horsford, Colonel Close, Major Gibson, Captain King, etc.

"The trials commenced at eleven o'clock and occupied nearly the whole of the day. The first weapon experimented upon was the 'new chain gun' of which there were two descriptions on the ground; *viz.*, one fixed on framework, showing the applicability of the 'chain' to field pieces, the other being fired from the shoulder, the barrel having a rest, which would always be obtained by a breastwork, or other fortification. This was not intended for target practice, consequently the range was limited, but rather to show the rapidity with which the gun could be fired, the average being thirty shots in one minute, and that with the greatest precision.

"The term 'chain gun' may not perhaps be generally understood; therefore, in explanation, we may say that the invention consists in a 'chain' of 'chambers' which can be extended to any number, of any size, and by a simple action of the hammer in cocking the gun a double wheel revolves and brings the chamber, already charged and capped, into position, when by an equally simple movement the barrel becomes hermetically sealed and prevents the possibility of the slightest escape of gas, and the cartridge is so constructed as to allow any number of shots to be fired at the minimum rate of thirty per minute without injuring, heating, or fouling the barrel, which is a 5-grooved one. With regard to the other description of chain gun, the 'hand-chain rifle,' we might mention that the experiments proved equally satisfactory, the chambers and other arrangements being of the same construction as those of the gun we have already described."

The writer then went on to give an account of Treeby's breech-loading rifle (patented October 16, 1858), whose main feature consisted of an ingeniously designed sleeve bolt which locked to the rear end of the barrel by means of an interrupted-thread screw, the handle of the bolt being formed in the shape of a *C*, which clipped around the grip of the butt. The action was suitable for the conversion of any muzzle-loading rifle or musket and the writer described it, somewhat speciously, as being possessed of all the advantages of other types, without their defects. It appears to have won the approval of several experts, but the authorities made no attempt to adopt it.

THE second trial of the "chain gun" took place at Hythe on July 15th in the presence of General Hay and Colonel Wilford (first and second instructors of musketry) and of the various officers attached to the establishment. The booklet gives relatively little information about this trial apart from showing a reproduction of the very satisfactory grouping which was made on the target by a belt of 30 chambers, discharged in 1 minute 20 seconds at a range of 200 yards. A similar number previously had been fired in one minute. It is fairly obvious, however, that the observers at both these trials were impressed by the gun's performance, and the *United Service Gazette* (whose representative had attended an earlier private demonstration) made these comments in the issue of June 4, 1859:

"At a time when the thoughts and the energies of this country are bent on a system of national defense, nothing could be more welcome than a weapon adapted exclusively to defensive purposes and capable of operating powerfully in an incredibly short space of time. We, therefore, perform a duty in bringing into prominent notice a new 'revolver', which owes its origin entirely to Mr. T. W. Treeby, a gentleman of great skill in the mechanical line as applied to firearms. This gun is so constructed that the cartridges hang in a chain in front of the trigger guard, and by the action of the trigger are rapidly brought up, one by one, into the barrel and are as rapidly discharged.

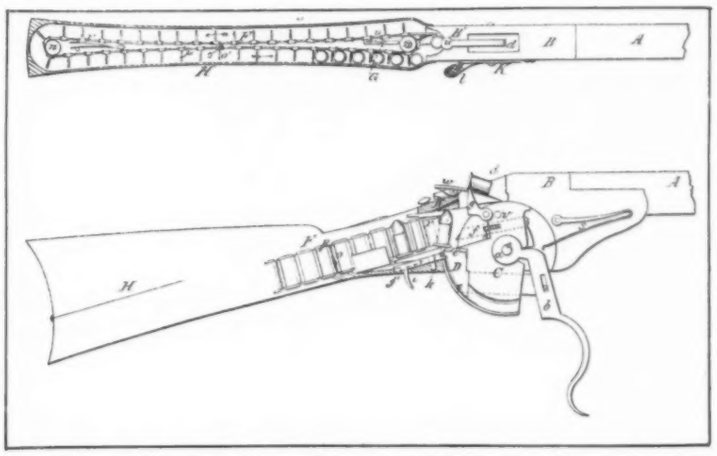
"Some idea may be formed of the quickness of the fire when we mention that the piece may be discharged thirty-three times in a minute. Almost any number of shots can be delivered without the gun requiring to be cleaned. Thus, if an enemy were advancing up a sea beach or across a field at a distance of 400 yards, 100 of these chain rifles, in the hands of good marksmen, would annihilate 5000 men in 2 or 3 minutes! Were cannon constructed upon the same principle for firing shells, grape, or canister, the whole of an attacking army might easily be destroyed. The rifle is, we believe, before the Ordnance Department of the War Office for inspection."

The Government, however, never made any move toward adopting Treeby's invention either for small arms or for ordnance. His original patent had, of course, embodied the possible application of the belt of chambers to the latter type of arm, but it is very doubtful if any experiments actually were made in that direction. Quite apart from the fact that the number of chambers which could be fitted to a cannon of any useful size would be severely limited by sheer bulk and weight, it is almost certain that the system of connection between them and the barrel never would have stood up to the terrific pressure of the charge. It is true that the report of the first trial makes mention of the testing of a model fixed in a framework to show "the applicability of the 'chain' to field pieces," but no indication is given as to its dimensions or caliber, and it actually may have been nothing more than a skeleton model of the shoulder arm. In any case, even if it had been proved that the system could be successfully applied to cannon of the ultralight type, there would have been relatively little chance of the authorities making any use of it in this connection, for the introduction of a more powerful and accurate service rifle had brought about, at this period, a policy of artillery standardization which had swept the smaller-caliber ordnance into obsolescence.

In fact, Treeby only could hope to secure official patronage through the medium of a multishot rifle. This type apparently had worked in perfectly satisfactory fashion during the course of the trials, and it undoubtedly possessed the faculty of *sustained* rapid fire far in advance of any other arm of the period. Its construction was not unduly complex, but it would, on the other hand, have requied a fair amount of attention to keep it in good working order, and this, coupled with the question of how it would stand up to the exigencies of active service, may have caused the experts to regard it with some uncertainty. Its main defect was, however, its lack of fire power.

THOUGH no details are given of the guns which were used at the two trials, it is safe to assume that they were similar to the one illustrated here, for Treeby's demonstration models appear to have been built on a more or less uniform scale of dimensions, with a .50-inch caliber. Definite information regarding their load capacity and effective range is lacking, but his booklet states one interesting fact—that the charge used at Hythe was only three-quarters of a dram of powder to each chamber. This remarkably small load—roughly equivalent to that of the caliber .50 English "Deane-Adams" revolver—actually may not have represented the maximum that could be used, but it is fairly evident that the load was decidedly restricted.

The reason for this lay mainly in the fact that the deeply recessed mounting of the nipples (an essential feature of the design) took up a considerable amount of the loading space in the chambers. A belt of these, constructed to handle the "Enfield" cartridge (caliber .577 bullet, 2½ drams of powder) obviously would be of such weight and size as to render its use with a manual arm quite impossible. Apart from this, the question of gas pressure at the chamber-barrel joint would have to be taken into consideration. Three-quarters of a dram of powder, or slightly more, probably would give no trouble, but it is fairly certain that anything approaching a full military load would entail considerable leakage. This limitation of the "chain gun" was, no doubt, largely the cause of its eventual rejection.



THE HUGHES MAGAZINE GUN, 1864, FROM U.S. PATENT NO. 45,043—AN AMERICAN APPLICATION OF THE CHAIN PRINCIPLE

EDITOR'S NOTE.—The author of this article has established a unique reputation in England as a research student of the history of firearms. Two of his monographs have appeared previously in these pages. In the September-October 1936 issue (Vol. XVII, No. 98) he presented an historical review of the famous "pepper-box" pistol—that strange weapon with revolving barrels which held some prominence during the first half of the nineteenth century. Again, in the January-February 1938 issue (Vol. XVIII, No. 106), he described the Adams revolver in an exhaustive analysis.

ARMY ORDNANCE feels that in presenting studies of this kind from time to time it performs a twofold function. Frequently, data on earlier types of weapons—large and small—are not assembled in one accessible place; hence convenience of reference as well as authenticity is provided. More important, however, is the function of describing the processes and steps in the evolution of weapons from their beginnings up to the present day. That the machine-gun belt had anything like a crude counterpart in the Treeby gun is more than a coincidence. It is proof of the amazingly simple fact that our weapons progress as civilization itself goes forward. The record of the one is written in the other.

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Month by Month

EDUCATIONAL ORDERS FOR THE PRODUCTION of noncommercial articles of armament in time of peace have raced, within a period of less than a year, from a dead start to almost full speed under forced draft. To attribute this extraordinary popular reception to any one cause would be an error. Whatever the cause, the fact is that educational orders have advanced from a $2,000,000 program to a $32,000,000 plan almost overnight. The pages of this journal for nearly twenty years have outlined from every conceivable point of view the advantages—and the difficulties—of an educational-orders program. It is not now necessary to recount any of these. Rather the enormity of the transaction; *i.e.,* from zero to $32,000,000, being so great, two basic ideas may be well worth keeping in mind during the months that are ahead. Educational orders, be it remembered, are a responsibility of the military establishment and industry alike.

The first of these two ideas concerns itself with that mental attitude of our people and their representatives which swings so quickly from disinterestedness to either approval or disapproval. Just a few short years back and one who urged educational orders might be—indeed actually was—condemned for suggesting that low bidder need not always govern such purchases under our democratic processes. The art of arms production is a dead art unless certain publicly supported establishments keep that art alive. If private industry will be called upon to operate in that art in time of war, then it must be educated along practical lines with cost a secondary consideration. But along came a series of incidents which shocked the shallow minds which had come to think of war and peace as matters of bargain and sale. What with terrific propaganda against monarchy wherever found, and equally terrific propaganda against certain powerful, friendly states, the defense pendulum has swung in a brief time from one extreme to the other. Now we are in that stage where practical things are thought about after years of somewhat disgusting ideas and ideals about armament. Remember too that five years ago anyone who espoused the cause of the arms maker was by that act a sinner. Today it would seem the same advocate is a candidate for canonization. Therein lies the proof that all the people can't be fooled all the time.

But the second basic idea is extraordinarily more important. The job of administering educational orders, having grown in mushroom fashion from nothing to full bloom, the curriculum becomes of first importance. If there is to be an educational-orders program to cost $32,000,000 and to be administered within the next two years, then the comprehensive character of the educational order itself, what it is to accomplish and how it is to work, had best be developed slowly. The smaller program has scarcely begun. It has pitfalls undoubtedly. It is circumscribed with official interpretations and regulations inherent in all government business; it cannot have the flexibility characteristic of commercial transactions where both parties are free to set their own terms. The truth of the matter is that the first year of educational orders, now that they are actualities, should be considered a year of trial and error on both sides. Industry, not having made armament during the piping days of peace, cannot be held too closely to task, if by returning to the classroom it finds a course in dead languages a little disinteresting. Government must not be expected to handle such courses with all the certainty of the ageing professor who has taught his apt pupils a standard subject matter for years.

Thus when the larger educational-orders program gets under way, now that our defense-minded people realize that they live in a world of reality and not of political trickery—these things had best be taken into consideration else we may find ourselves in the awkward position of having urged a course of action so long that we have become incapable of following it in fact. One of the big advantages of the philosophy of educational orders is this: It provides arms-production experience in time of peace when the helter-skelter of war emergency is not upon us. Therefore we should not expect this newest form of industrial preparedness to keep pace with the speed of popular opinion. The one is in proportion to the size of the newspaper headline and therefore is swingable. The other, that is learning the technique of arms production, is far less changeable. We would do well to accelerate a little more slowly whether the makers of headlines are interested in it a month hence or not.

QUANTITY PRODUCTION OF ARTILLERY AMmunition in time of major war is a matter of very first military importance. Ammunition in whatever form—artillery, small-arms or bombs—with all its component parts, comprises the most expendable item of military equipment after food and fuel. As a nation, our country is well equipped for the supply of food and fuel. It is not so fortunate regarding the supply of ammunition. The best it can do in time of peace is confined to keeping the art of production in conformity with the very latest advances of skilled personnel, machine-tool design, handling and maintenance. But these are the province, under modern industrial conditions, of the production engineer. Whether or not American fighting forces in the wars that may come are adequately stocked with modern artillery ammunition is now the responsibility of the trained production engineer.

Thus, with considerable pride, we direct attention to the article, "Artillery Ammunition Production", on page 273 of this issue. Its author, Lieut. Col. Levin H. Campbell, Jr., would demand—did he know these lines were being written—that any personal references be eliminated. His unexpressed wish will be followed. We hail the organization at Frankford from the commanding officer, Colonel Bricker, to the last civilian artisan who has a part in this enterprise. Likewise, the technical and administrative officials in the Office of the Chief of Ordnance at Washington are to be congratulated. One and all they are blazing a trail in production engineering.

There are many reasons why the laboratory methods of Government establishments are seldom abreast of commercial practice. Government enterprise has no board of directors which, knowing the merits of a new technique versus an old, can decide promptly to replace obsolete equipment. Government's checks and balances will always tend to slowness. But now that production engineering in civil life is the basis of supply and maintenance, so must it perforce become in things military.

Frankford has high-speeded artillery ammunition production. In so doing its prime purpose is *method* and not numbers. But if this step in quantity production is properly nurtured it will remain as it is now, a current training center for a vital art. Its methods may be subject to improvement now; they certainly will be as machine design improves. The whole idea of production engineering in this field as well as in all others requires constant replacement of old machines and old ideas. Thus will Government arsenals do the job for which they are intended—the development of the art of armament making. Thus also will private industry be assured of a place where it may learn. And finally, through the balancing of two such media—the Government laboratory and the private plant—will a war-time supply of artillery ammunition be assured. While we are about it let us streamline the whole art of defense. The quicker the better.

THERE HAS RECENTLY COME TO OUR EDITorial desk Volume I of the Official History of the Canadian Forces in the Great War, 1914-1919. It comprises two books: the first is text by the author, Col. A. Fortesque Duguid; the second, appendices and maps. The period treated is from the outbreak of the war to the formation of the Canadian Corps when the 2nd Canadian Division joined the 1st in France; *i.e.*, from August 1914 to September, 1915. There are ten maps and diagrams in the text while in the separate volume of appendices there are fourteen general battle and situation maps. This is magnificent official history.

Colonel Duguid is director of the Historical Section of the General Staff at Ottawa. He has been engaged on this work since 1921. In what has been assembled here as well as in the plans for the volumes to come there is every evidence of thorough research and authentic presentation such as only historical endeavor of the first rank can typify. We congratulate our very good neighbor on this stirring record of war service.

In the period covered by this first volume two most important phases of the Canadian effort are recounted. There is the period during which the First Contingent of 31,000 men was raised and sent overseas. Next is the fighting by the 1st Canadian Division at Ypres, Festubert and Givenchy. Projected volumes now in preparation will carry the record through those other terrific engagements in which the Canadians established their fame as soldiers of the finest mettle. How gallant and how brave the figures best describe: 628,462 served; 60,661 did not return.

Later these volumes will be reviewed in the regular way in these pages. But our purpose here is to congratulate our neighbor and to pinch ourselves. Where is our own official history of the United States forces and when will it appear? Some splendid work has been done by our scholars and research workers under the Historical Section of our own General Staff. Some monographs have been issued under various auspices telling the story in part or in the light of the experiences of one individual. Now that twenty years have gone it is high time that ample facilities be made available to the Historical Section to begin the issuance of the official history of the American Forces in the World War. It seems that there are people going up and down the country engaged on "writers' projects" of all sorts, writing about everything under the sun, whose efforts might be thus directed. After all, it matters little how many filling stations there are in Whatsis County, or the exact date when bustles went out of fashion and the Garment Center in New York took control of American clothing. But the glorious record of American fighting men—complete, unabridged and exhaustive—does matter. We must hang our heads in shame until such a record as Canada has begun is also presented for ourselves. Our military authorities should be given all the assistance they need at once to bring this about.

THE NEW ANTITANK GUN DEVELOPED BY THE Army is creating a great deal of favorable interest. And well it should. Known as the M3 on the carriage M4 it is a weapon of great accuracy, simplicity of fire control and superior penetration. Trailed behind a one-half ton truck, the gun and carriage complete weigh about 850 pounds. The elevating and traversing controls as well as the trigger and sight are so arranged that the gunner can sight, track and fire the piece simultaneously. It can be fired at a rate of more than twenty-five rounds a minute.

Two kinds of ammunition will be used. The armor-piercing type will penetrate armor of any known light or medium tank at 1000 yards. High-explosive shell will also be provided. The mobility of the piece is such that it can be trailed at the rate of forty to fifty miles an hour without skidding. It is said to negotiate gullies, shell holes and slopes as steep as twenty-six degrees. The new piece was shown in illustration in the last issue of this journal on page 202. The caliber is 37 mm.

And so another antidote appears to allay whatever fever the tank has caused. At least this new weapon should reduce those extreme estimates of tank power which frequently have judged that vehicle to be far more potent than it actually is. And having so declared there is nothing in our declaration to deprive the tank of a very useful and extremely important function in modern battle. It is simply the old battle of neutrality all over again. It is the seesaw between attack and counterattack, offense and defense, aircraft and antiaircraft, tank and antitank. But there is gratification that our engineers have produced a real defense against tanks.

THE COMMITTEE OF THREE HUNDRED ON Twentieth Anniversary of the Army Ordnance Association under the chairmanship of Col. Frederick H. Payne, is actively coöperating in plans for a mammoth industrial preparedness dinner to be held in New York on the evening of April 5th. Representatives of the leading military and professional engineering societies have formed a Conference on National Defense under whose sponsorship the dinner will be held. Brig. Gen. Samuel McRoberts, chief of the New York Ordnance District, assisted by representatives of the other procurement branches of the Army, is chairman of the conference and will preside at the dinner. Colonel Payne will be toastmaster.

The feature address at the dinner will be given by Hon. Louis Johnson, the Assistant Secretary of War, who has led the forces of industrial preparedness with distinction during nearly two years. It is particularly appropriate that the Assistant Secretary be thus honored. In addition to his own qualities of personal leadership he is, officially, the responsible head of industrial preparedness under the National Defense Act. His office directs the study and current application of procurement planning. Through the three agencies under his immediate direction—the Army Industrial College, the Planning Branch and the Current Procurement Branch—he acts as the peace-time dean of industrial-preparedness studies. Likewise, the members of industry and of the professions who attend will be honored by his presence.

It is the hope of the conference that this occasion will help to focus nation-wide attention on the importance of industrial preparedness both as a principle of national security and particularly as a responsibility of the current armament program. All members of the Army Ordnance Association will receive personal invitations to attend.

MENTION OF THE COMMITTEE OF THREE Hundred on Twentieth Anniversary of the Army Ordnance Association, recalls that Colonel Payne's organization is functioning on fifteen different fronts. There are that many sections of the committee throughout the country. Some have already organized in splendid fashion, others are beginning to get under way.

The purpose of the committee is to encourage and diffuse knowledge of military armament for our national defense. The need for a better understanding of industrial preparedness is particularly urgent at this time.

It is hoped that all sections can arrange at least one general meeting of local members and prospective members during the year. If possible two meetings—one in the early part of the year and one in the latter part—would be timely. Frequently local engineering, industrial and commercial organizations will coöperate in such meetings, thus providing a larger audience of executives and engineers who should be familiar with industrial preparedness. Plans will be announced later for an annual meeting, probably at the Aberdeen Proving Ground, commemorating the founding of the Army Ordnance Association and the beginnings of industrial preparedness twenty years ago.

It is also a definite objective of the Committee of Three Hundred to double the membership of the Association.

As an incentive to members, the national officers will award the following decorations for special service during the year 1939 on the Anniversary Committee: (1) To the member who obtains 10 group members or 75 individual members, the Association's medal in gold mounted on the Association's colors and suitably inscribed; (2) To the member who obtains 5 group members or 50 individual members, the Association's medal in bronze mounted on the Association's colors and suitably inscribed; (3) To the member who obtains 3 group members or 30 individual members, the Association's lapel emblem in gold; (4) To the member who obtains 1 group member or 15 individual members, the Association's lapel emblem in silver; (5) To the member who obtains 10 individual members, the Association's lapel emblem in bronze.

The officers of the committee hope that the list of candidates for these honors will have grown, by the end of the year, to rival that original band who, twenty years ago, started the industrial preparedness movement and called it the Army Ordnance Association.

AN INCREASE IN PERSONNEL OF THE ARMY coincident with the armament program has been requested. The War Department has asked the Congress to authorize a total increase of 40,484 officers and men. In detail, this increment would be divided as follows: additional Regular officers of the Air Corps, 1565; Reserve officers on extended active duty, 603; additional enlisted men of the Air Corps, 25,143; additional flying cadets, 808; increases in other arms and services, 500 officers and 5285 men; additions to the Panama Canal garrison, 180 officers and 6400 men. These projects are in addition to any reported plans of the National Youth Administration and the Civil Aëronautics Authority to train airplane mechanics.

The enlisted increase in the Air Corps would be acquired in monthly increments of 700 each during the current fiscal year; 1000 a month during the first six months of the fiscal year 1940, and 3720 during the last half of that year. The total would be 25,143 men.

The War Department proposes to meet the increase of 500 officers and 5285 men for the arms and services partly by calling Reserve officers to active duty in the Ordnance Department, Signal Corps, and Quartermaster Corps. Similarly 200 Reserve officers would be used by the Medical Corps.

The total enlisted strength of the Army, under this plan, would be 202,500. The enlisted strength now is 165,000. For this increase no authorization of law is necessary, only the funds must be appropriated. However, present plans contemplate an amendment to the National Defense Act to provide that 50 honor graduates from senior R.O.T.C. units be commissioned yearly. Also the present law would be amended to permit Reserve officers of the Air Corps to continue on active service for seven years instead of five.

As a point of more than passing interest, the provisions of the National Defense Act of 1920 relating to the strength of our active armed forces are apropos. The act authorizes an enlisted strength of 280,000 men. For years the Army has gotten along with 115,000 less than that. What with the increased job, certainly all functions must be strengthened. Mechanized defense has not decreased the need of men—it has lessened the burden and increased safety in battle.

The Armament Program

An Editorial

THE country has become defense-minded in a big way! No longer is serious attention paid to those nit-wit forces which only four years ago seemed well on the road to make of us a nation of left-wing pacifists. Now, groups that formerly harped upon the national defense as "not socially beneficial" are swelling the chorus to arm. This transition, being acute, demands that a few basic things be thought through now. The armament program is far too serious to permit of false attitudes especially at the start.

About the wisdom of the program there can be no *bona fide* doubt. Nor can its importance in its three essentials be seriously questioned. These three essentials are each of vast meaning; combined they form an objective the like of which our people have not sought ever before in time of peace. Until now the things we are about to do for the defense of the United States have not been done until an emergency of war was upon us. That they are to be done now—while there is peace—is a fairly good assurance that there will be no war. In this strength to defend and thus to prevent conflict lies the transcendent value of our armament program.

These three essentials of the program, as we see them, are easy to identify in their order of priority. They are: 1. War reserves of critical military equipment, including ordnance and aircraft of modern design; 2. Educational orders for noncommercial armament; 3. Increased air power. In the order of cost, increased air power comes first; in the order of military necessity, war reserves take precedence. In either method of gradation, educational orders stand midway. But, be it said again for emphasis, these three are the essentials of the program. If they are attended to properly and in time there will be slim chance of major war for us in the near future.

Should an observer be tempted to conclude that any one of these—the big three—is a necessity which has come into prominence overnight, let him be disillusioned. There is no student of military affairs among us who has not contended insistently for years that each of these is a crying necessity. The record contains scarcely a page whereon this plea is not recorded. Let us see why.

WAR reserves of modern fighting equipment are important for one big reason: They must be *in being* at the beginning of a conflict to tide over a fighting force until private industry can produce that equipment in quantity. This is an axiom of industrial preparedness. It is also a glaring failure of our past history. Consequently the general demand today that modern war reserves be built is both novel—because unusual, and gratifying—because sound. Remember that we are only a generation removed from a school of thought which held that war reserves could be obtained overnight. Recall the Bryan jargon about a million men springing to arms overnight. Until then war reserves had not been thought much about at all despite a bad case of jitters in the Spanish-American War.

We have said that educational orders stand midway in the new defense program. This is so because educational orders in our modern military defense philosophy follow closely upon the adequacy of war reserves. Without the reserve the orders are a waste of time and effort. The reserve must be just big enough but not too big. It would be preposterous to plan a stock pile of war reserves adequate to fight any unknown war to victory. Therefore, under our practice, we plan to have only a large enough pile to keep an army going until private industry gets into harness. If the harnessing is going to be slow the reserve pile must be large. If the harnessing is going to be fast the pile can be small. The exact size of the pile depends principally upon the speed with which private industry can begin and continue to produce. That speed has only one brake—knowledge. Educational orders are to provide that knowledge.

Thirty-two million dollars of public funds for educational orders during the next two years is a tremendous step from the present authorization of $2,000,000 a year. Elsewhere in these pages we have intimated the responsibilities arising from so great an advance. But a defense-minded people who have been quickly convinced of the logic and the economy of this type of defense will want the best that this program can provide.

FINALLY, our air power.—The armament, *i.e.*, ordnance, phase of our air power itself is of first importance. This is an Ordnance problem. After all, our people, defense-minded and air-minded as they are, must be also ordnance-minded. This simple truth was best expressed some years ago when the then Assistant Secretary of War, Col. Hanford MacNider, expressed the thought somewhat in these words: "The only thing an airplane without ordnance can do is give the enemy a dirty look." The aircraft armament program indicated by the air program is itself of momentous proportions and will require new outlooks, new procedures, and new devices else the demands will be unwarranted and unachievable.

Looking at a major aircraft program in terms of ordnance alone, one can envision problems of matériel of complex design and meticulous performance. Consider that air power embraces such ordnance as bombs, their fuzes, explosives, racks and sights; aircraft machine guns and cannon; pyrotechnics and their discharge mechanisms, and fire-control instruments. The universality of the ordnance engineer in a defense program is here shown. His responsibilities are coequal in aircraft and antiaircraft defense.

These are the kinds of things the country generally should think through now. The President's rearmament message, which we have published in full elsewhere in this issue, is admirable both in tone and content. In that it proposes to increase our air power it proposes wisely. In that it looks to educational orders and our war reserves of ordnance it does most wisely. Its provisions for added protection for the Panama Canal and additional naval bases and air bases seem sound. For such a program takes cognizance that in this generation the voice of power is stronger than all other voices put together. Present and pending programs plus that designed in the message will go far to provide for the necessary increases in our fighting forces at the moment and also provide a basis for further expansion whenever necessary. Thank God that our people seem determined to forge the armor for the defense of their own. And the armor is to be forged not in war—but in peace. This is an American phenomenon entirely unknown to us until now.

Association Affairs

Chicago Post

THE annual meeting of the Chicago Post, Army Ordnance Association, was held at the Chicago Club on the evening of January 12th. One of the largest gatherings of members of the Post and their friends assembled for dinner at which Edmund A. Russell, president of the Post, presided. The guest of honor was Maj. Gen. Stanley H. Ford, commanding general, Sixth Corps Area.

General Ford addressed the meeting on the importance of industrial preparedness, particularly at this time. He described the policies of the War Department as to the authorization of military strength in man power and matériel. He praised the procurement-planning activities of the Ordnance Department and complimented its officials in Chicago, particularly Fred. A. Preston, district chief, and Mr. Russell who organized the Chicago Ordnance District during the World War and was its first head.

Brig. Gen. C. T. Harris, Jr., Assistant to the Chief of Ordnance and chief of the Industrial Service of the Ordnance Department, addressed the meeting on industrial-mobilization planning. Mr. Preston also spoke as did Lieut. Col. A. B. Johnson, executive officer of the district, and Lieut. Col. L. A. Codd, Ord. Res., editor of Army Ordnance.

The assembled guests paid a well-deserved tribute in their greeting to Mr. Russell. Many of those in attendance had served with him when, as chief of the Chicago Ordnance District during the World War, he mobilized the resources of that area for ordnance production. Mr. Russell continued as chief of the district for many years and when Mr. Preston succeeded him, Mr. Russell assumed the presidency of the local chapter of the Army Ordnance Association. He is also a national director of the Association. His long and energetic service to the Ordnance cause is esteemed throughout the country. This fact was attested by the military and industrial leaders who attended the meeting.

The officers of the Chicago chapter, in addition to Mr. Russell as president and Colonel Johnson as secretary, are: vice-president: F. W. Parker, Jr.; directors: W. R. Wright, W. H. Damon, Hugo Diemer, F. A. Preston, G. G. Thorp, W. B. Hobbs, C. A. Tibbals, Jr.

Milwaukee Post

BRIG. GEN. C. T. HARRIS, JR., Assistant to the Chief of Ordnance, was the guest of honor and principal speaker at the annual meeting of the Milwaukee Post, Army Ordnance Association, at the University Club, Milwaukee, on the afternoon of January 12th. General Harris addressed the members of the chapter, comprising many of the leading manufacturers and engineers of Milwaukee, on the present ordnance production program. He described the increased production in which the Department now is engaged and presented an analysis of its policies in this field and also in respect of the educational-orders program. Following his address, questions were submitted from the floor so that those in attendance were enabled to obtain a comprehensive picture of the Department's activities and of its plans for the future.

General Harris was introduced by Col. W. W. Coleman, president of the Post and first vice-president of the national Association. Colonel Coleman served during the World War as a special assistant to the Chief of Ordnance in connection with the program for artillery production and during the intervening years has been a leading proponent of industrial preparedness. He was one of the earliest advocates of educational orders for ordnance production and has fostered also the activities of the local chapter in every way toward the advancement of industrial preparedness.

Lieut. Col. A. B. Johnson, executive officer of the Chicago Ordnance District, also addressed the meeting as did Lieut. Col. L. A. Codd, Ord. Res., editor of Army Ordnance. Colonel Johnson described in particular the new semiautomatic rifle and demonstrated its method of functioning. He disassembled and assembled the piece and allowed those present to examine the weapon both from the standpoint of the user and the manufacturer.

Preceding the meeting, General Harris and his party were the guests of Colonel Coleman at luncheon at the University Club to which a number of the principal business men of the city had been invited.

Cincinnati Post

THE annual election of officers of the Cincinnati Post, Army Ordnance Association, was held December 20, 1938. The newly elected officers were inducted into office at a luncheon at the Queen City Club, Cincinnati, January 18, 1939. The roster of officials of the Post follows: President: L. W. Scott Alter; vice-president: Fred. V. Geier; treasurer: Lieut. J. D. Wyatt; directors: A. E. Muller, R. K. LeBlond, B. B. Quillen, Lieut. Col. A. H. Pugh, S. M. Rowe, S. G. Kuhn, J. T. Faig, and Lieut. Col. A. W. Lissauer; director of the national Association: W. W. Tangeman; and secretary, Maj. F. A. McMahon. At the luncheon, plans were made for the activities of the Cincinnati Section of the Committee of Three Hundred on Twentieth Anniversary.

Mr. Alter, the new president of the Post, succeeds Mr. Tangeman who was elected to serve on the board of directors of the national organization. Major McMahon was secretary of the Pittsburgh Post some years ago during the presidency of the late Ralph Dravo.

Boston Post

DR. GEORGE B. WATERHOUSE, professor of metallurgical production at Massachusetts Institute of Technology, was the principal speaker at the meeting of the Boston Post of the Association held at Walker Memorial, M.I.T., on December 7, 1938.

Dr. Waterhouse, the retiring president of the American Society of Metals, spoke on "Manganese—A Strategic Material." He is an authority on the use of steel and its alloys, and the large audience found his address very illuminating and displayed a lively interest in the subject.

C. S. Robinson is president of the Boston Post. The other officers are: C. W. H. Cowdrey, vice-president; T. L. Ames, R. J. Thanisch, M. T. Carney, A. E. Anderson, C. E. Fuller, W. Van Pattensteiger and R. E. Goho, directors; J. S. Crawford, secretary.

Los Angeles Post

MAJ. GEN. HENRY H. ARNOLD, Chief of the Air Corps, U. S. Army, delivered the principal address at the annual meeting of the Los Angeles Post, Army Ordnance Association, February 8th. The meeting was held at the Los Angeles Athletic Club at 7 P.M. General Arnold's address is published elsewhere as an article in this issue.

Earl B. Gilmore, president of the Post and toastmaster of the meeting, had arranged a program of unusual significance for members and guests who attended. In addition to General Arnold, other ranking military officers were present and also leading

manufacturers and industrialists of Southern California. Arrangements for the dinner were in charge of a committee headed by Maj. Ralph Cook Scott, Ord. Res., secretary of the Post. As this issue goes to press, complete reports of the meeting have not been received but will be published later.

St. Louis Post to Meet

ELABORATE plans are being made by the officers of the St. Louis Post for the annual meeting of the Post to be held on March 9th at the Coronado Hotel, St. Louis. The guest of honor will be the Chief of Ordnance of the Army, Maj. Gen. C. M. Wesson. Edwin B. Meissner, president of the chapter, and Maj. H. M. Reedall are actively arranging the program.

Col. Harry Scullin, chief of the St. Louis Ordnance District, and Willard M. Cox, assistant chief, are planning to have a large representation of business executives, engineers, and Reserve officers to greet the guest of honor. General Wesson will be accompanied by Brig. Gen. C. T. Harris, Jr., chief of the Industrial Service, Ord. Dept., who also will address the meeting.

The other officers of the Post, all of whom are serving on the committee of arrangements, are: Lieut. Col. William Carter Bliss, vice-president; E. W. Davis, H. B. Deal, W. H. Bixby, and J. M. Kurn.

The Army Ordnance Shield

IN response to requests of many members, the emblem of the Army Ordnance Association is now available in the form of an artistic wall plaque. This consists of the Association's insignia in bas-relief upon a shield. The shield measures eight inches in width by nine inches in height. The emblem is cast in plaster; the insignia is finished in bronze, the shield in maroon. The modeling and casting are the work of Albert N. Ward, whose artistic work in plaster is well known in the Nation's Capital.

The shield is a most attractive ornament for home or office. Its colors will blend in library and study. The emblem is for sale to members only. It will be delivered securely packed and boxed, insured, postage prepaid, to addresses in the United States at $3.00 each. A drawing of the shield is shown in the notice on page 299 of this issue. Orders, accompanied by remittance, will receive prompt attention.

Retirement of Albert C. Munz

ALBERT C. MUNZ, who for many years has been in charge of seacoast cannon production at the Watervliet Arsenal, Watervliet, N. Y., will complete an unusual record of public service when, by operation of law, he retires March 31, 1939. This service, extending over forty years, typifies the loyalty of that great body of artisans who keep alive ordnance manufacture in the various Government establishments.

Mr. Munz began his service at Watervliet as a toolmaker on December 5, 1899. He was promoted to an assistant foreman in 1913 and foreman in the following year. In 1927 he was placed in charge of the seacoast cannon shop, in which position he has been responsible for the fabrication and assembly of all large-caliber guns produced in the arsenal. He was largely responsible for introducing the present process of oil impregnation of the wood blocks used for packing reamers and boring heads now used in making large-caliber guns. Prior to the use of the pressure-vacuum process, these blocks merely had been soaked in oil in open tanks. This secured only a shallow and slow penetration of the oil. The improved process is both expeditious and thorough.

The process of rough boring gun tubes was also improved under his direction. Previously, rough boring had been carried from one end through the entire tube. The improved practice is to bore half way from each end, thus very materially minimizing the "run-out" and avoiding rejections which might otherwise be occasioned.

New Members

DURING the period December 1, 1938 to January 31, 1939, inclusive, the following applicants were admitted to membership in the Army Ordnance Association: Alfred Africano, Yonkers, N. Y.; Clark B. Allen, Port Richmond, S. I., N. Y.; Gordon R. Ashley, St. Louis, Mo.; Joseph L. Auer, Pelham, N. Y.; Hartley W. Barclay (Life Member), New York, N. Y.; Julius H. Beers, Ann Arbor, Mich.; Charles H. Bell, New York, N. Y.; Joseph Bell, Darlington, Wis.; Louis R. Blanks, Woodbury, N. J.; Richard C. Bodenhamer, El Dorado, Ark.; R. J. Carper, West Pittston, Pa.; Edward S. Chamberlain, New York, N. Y.; W. H. Cheffey, Swissvale, Pa.; James T. Cobb, Cincinnati, Ohio; W. A. Conner, Bridgeport, Conn.

H. C. Disston, Philadelphia, Pa.; J. S. Disston, Jr., Philadelphia, Pa.; S. Horace Disston, Philadelphia, Pa.; Walter J. Doyle, Silver Peak, Nev.; Russell E. Duncan, New Britain, Conn.; William Easterbrook, Jr., Philadelphia, Pa.; John Brooks Emory, Birmingham, Ala.; John L. Engelhardt, Brooklyn, N. Y.; Rudolph H. Fox, Denver, Colo.; Glenn Fullenwider, Montesano, Wash.; J. M. Goodpasture, Philadelphia, Pa.; Vladimir A. Grodsky, Washington, D. C.

D. J. Hawthorne, LaSalle, Ill.; J. H. Hirsch, Chicago, Ill.; K. H. Hobbie, Chicago, Ill.; Randall J. Hogan, Pittsburgh, Pa.; John R. Hopkins, Denville, N. J.; Robert J. Irvine, San Marino, Calif.; Otto M. Jank, Berkeley, Calif.; William H. Klippert, Akron, Ohio; John W. Knight, Pittsburgh, Pa.; C. L. Koehler, Cincinnati, Ohio; Frederick W. Krebs, Cleveland, Ohio; Eugene R. Kulka, Brooklyn, N. Y.; Arthur J. LaCroix, Southbridge, Mass.; Houston S. Landon, Chicago, Ill.; Harry E. Leeper, Fairmont, W. Va.; Henry B. Lockwood, Leonia, N. J.; N. M. Lower, Erie, Pa.; Herbert H. Luedinghaus, La Due, Mo.; Herbert B. Luria, New York, N. Y.; Edward Lynch, Lynn, Mass.

J. deNavarre Macomb, Jr., Chicago, Ill.; Lloyd B. Magruder, Jr., Cambridge, Mass.; Stephen Malatesta, San Francisco, Calif.; George W. Malone, San Francisco, Calif.; John E. Maxwell, Charlottesville, Va.; Richard B. May, Chicago, Ill.; James B. McCafferty, Los Angeles, Calif.; Roy M. McCutchen, Pittsburgh, Pa.; Colin McInnes, Jr., Beaver, Pa.; Vincent McManus, Williamsburg, Va.; Harry R. McMullen, Mt. Lebanon, Pa.; Leonard A. McQuown, Punxsutawney, Pa.; Alan H. Means, Salt Lake City, Utah; A. L. Mercer, Cleveland, Ohio; I. A. Mitchell, New York, N. Y.; Rowland B. Mitchell, Athol, Mass.; Anthony T. F. Moran, New York, N. Y.; William J. Morden, Bronxville, N. Y.; John Davis Morgan, South Orange, N. J.; Nelson Morris, Homewood, Ill.; John R. Morse, Cleveland, Ohio; Louis S. Morse, Jr., Detroit, Mich.; Simon Moskalek, Dearborn, Mich.

Lynton R. Newhall, Washington, D. C.; Arthur Noack, Garfield, N. J.; Harold R. Noren, Loch Raven, Md.; John L. Novak, Chicago, Ill.; Alvin A. Ostermeier, Dodgeville, Wis.; R. M. Overton, Pittsburgh, Pa.; Charles Penrose, Philadelphia, Pa.; Edwin M. Post, Jr., Long Island City, N. Y.; Preston B. Postlethwaite, St. Louis, Mo.; C. J. Priebe, Philadelphia, Pa.; John G. Priore, New York, N. Y.; Erskine Ramsay, Birmingham, Ala.; Paul C. Renno, Chicago, Ill.; S. T. Roberts, Philadelphia, Pa.; Robert B. Rochford, Hartford, Conn.; J. Albert Roesch, III, Chicago, Ill.; Kenwood Ross, Silver Peak, Nev.; Walter H. Rudolph, Newark, N. J.

Marvin F. Schmidt, Riverside, Calif.; Harold R. Seykota, Boston, Mass.; J. G. Shennan, Elgin, Ill.; Robert Sibley, Philadelphia, Pa.; Walter Siegerist, University City, Mo.; Richard L. Snyder, Jr., Glassboro, N. J.; E. K. Spring, Philadelphia, Pa.; Maurice G. Steele, Havre de Grace, Md.; Willis K. Strick-

land, Metuchen, N. J.; Horace E. Thornton, Rockford, Ill.; T. N. Tilley, Woodbury, N. J.; William E. Tretch, Philadelphia, Pa.; Francis Waddingham, Manhattan Beach, Calif.; James W. Walters, Cincinnati, Ohio; E. Morrison Webb, Pittsburgh, Pa.; Giles P. Wetherill, Philadelphia, Pa.; Russell Wiles, Jr., Chicago, Ill.; A. J. Wilson, LaSalle, Ill., and William L. G. Wolff, Wollaston, Mass.

NECROLOGY

CAPT. JOHN W. SLATTERY, ORD. DEPT., assistant to the commanding officer at the Delaware Ordnance Depot, Pedricktown, N. J., died suddenly December 21, 1938, at the depot. He recently had been transferred to Delaware after the completion of a most successful tour of duty as Ordnance officer at the Edgewood Arsenal, Md. In his death, the Army Ordnance Association, of which he was an active member, and ARMY ORDNANCE, to the pages of which he had contributed, are deprived of a friend and supporter at whose hands their interests were always forwarded.

CAPT. JOHN W. SLATTERY, ORD. DEPT.

Captain Slattery—"Jack" as he was affectionately called by his many friends—was born at Bellows Falls, Vt., June 22, 1838. He was graduated *cum laude* from Norwich University, Vermont, in 1912. An outstanding athlete in football and track, he was an enthusiastic horseman.

On November 4, 1917, he enlisted as a private in the Aviation Section of the Signal Corps and was promoted to second lieutenant in January 1918. In October of that year he accepted a commission in the Air Service, U. S. Army. He transferred to the Ordnance Department in 1922 and was promoted to captain in October 1930. During his sixteen years of service in the Ordnance Department, Captain Slattery had occupied posts of high responsibility both at Rock Island Arsenal, Edgewood, and Delaware. While at Rock Island he was president of the Rotary Club and secretary of the American Red Cross of the Tri-Cities. Characteristic of his Celtic energy were his work in the American Legion and his secretaryship of the Harford Horse Breeders Association in Maryland.

In his passing, Jack Slattery leaves as part of a rich heritage the memory of a generous, energetic, and sincere friend. To have combined the humor and determination of the Gael with the loyalty and straightforwardness of the soldier is a rare legacy and therefore of great value. It might well be his epitaph.

COL. GEORGE MONTGOMERY, well-known officer of the Ordnance Department, who retired from active military service in 1922, died at his home in New York City on December 8, 1938. He will be remembered especially by many officers and engineers who served in the Ordnance Department during the World War.

Born in County Cavan, Ireland, July 26, 1867, he received his early education under the tutelage of a famous local schoolmaster who was also his uncle. The thoroughness of the learning thus obtained is shown by the fact that when he came to America and took an open competitive examination for appointment to the Military Academy he won without the advantage of any special training. Graduated with the class of 1890, he served a short period with the Artillery when he accepted an appointment to the Ordnance Department. His Army career thereafter was spent in that branch of the service.

During the Boxer Rebellion he was chief Ordnance officer on the staff of General Chafee and later was assigned to various stations, subsequently becoming commanding officer at the Frankford Arsenal, Philadelphia, Pa. His record there is credited with improving the operating efficiency and effecting substantial savings in production costs. During the World War he was assigned to the Italian Army as liaison officer and during this period made an extensive study of the Italian method of storing ammunition. His last station was at the Augusta Arsenal, Augusta, Ga., in 1922.

As indicative of the high caliber of Colonel Montgomery's public service, we take the liberty of quoting from a recent letter of Maj. Gen. William Crozier, former Chief of Ordnance, which contains the following tribute to Colonel Montgomery: "When I became Chief of Ordnance I brought him to Washington to take charge of the financial affairs of the Department, which duty he performed with marked efficiency, making notable improvement in the fiscal relations between my office and the manufacturing arsenals, under which the funds appropriated by Congress were allotted and accounted for. I later assigned him to the command of the important Frankford Arsenal, the affairs of which he conducted with his usual energy and efficiency."

DR. CHARLES EDWARD MUNROE, dean of American explosives chemists, educator and inventor, died at the age of 89 at his home in Forest Glen, Md., December 8, 1938. He was well known among the Ordnance fraternity as a pioneer in the development and improvement of smokeless powder.

Born at Cambridge, Mass., in 1849, he was graduated from Harvard University in 1871. Immediately thereafter he began a career of teaching which included long service on the faculty of Harvard, the Naval Academy at Annapolis, and George Washington University. At the latter institution he served as dean of the School of Graduate Studies from 1903 until 1918. During his long career, his activities included many fields of chemical research. He was chairman of the Committee on Explosives Investigations of the National Research Council, chief explosives chemist of the U. S. Bureau of Mines, and consultant of the War and Navy Departments as well as the Forest Service. He was the author of more than one hundred books and papers on chemistry and high explosives. For his services to foreign countries he received many decorations and honorary membership in many scientific, professional, and educational organizations. He was a contributor to the pages of ARMY ORDNANCE.

Doctor Munroe spent seven years (1886-1893) at the U. S. Naval Torpedo Station, Newport, R. I., during which period he pioneered in the development of smokeless powder. This work was referred to by President Benjamin Harrison in 1892 as one of the most noteworthy achievements of his administration. But greater in Doctor Munroe's estimation, we believe, was the high regard in which he was held as gentleman and scholar by the world-wide circle of his friends in the technical, professional and national-defense services. His name ever will be closely associated with the epochal advances of propellent powder and military explosives as agencies of our national defense.

NOTICE also has been received of the death of the following members of the Association: Arthur W. Armstrong, Pittsburgh, Pa.; Dr. Arthur K. Kurtz, Philadelphia, Pa.; George V. Rhines, Pittsburgh, Pa., and Louis W. Stevens, Hartford, Conn. To their relatives and friends ARMY ORDNANCE, on behalf of the Association membership, extends condolences.

From the Record

The following quotations are from addresses or writings of recognized authorities and comprise a cross section of opinion on subjects closely allied to the national defense. They have been selected for publication as being important and timely. Through this medium, ARMY ORDNANCE *hopes to acquaint readers with official views regarding various phases of industrial preparedness.*

RECORDS OF THE PLANNING BRANCH OF MY office show that about seventy-five per cent of the specifications and drawings needed for the information of industry have been completed. When proposals were issued recently for educational orders, I was delighted to find that the necessary drawings and specifications were available at once for the semiautomatic rifle, the gas mask, the searchlight and the other items so far approved. There still are more than twenty-five per cent of our items, many of them vital to our cause, for which specifications and drawings have not yet been finished. A job three-quarters done is far from complete. I therefore direct you to bring all of your specifications and drawings up to date with all possible dispatch. . . .

In the interests of standardization you must strive toward the simplification of military machines and weapons. Some degree of complexity, I realize, is inescapable but we must try to hold it to a minimum. When faced with the alternatives between a complicated, delicately constructed machine of superior performance and one less perfect but more easily adjustable to mass production, we must choose the latter. We may have to accept something that is eighty per cent efficient which we can obtain rather than wait for a more perfect item which may be just around the corner. The standard may not be the most efficient that can be visualized, but if M-day comes tomorrow, we will have to go to production on that basis.

Keep before you as a constant reminder the purpose you expect to accomplish with a particular weapon or machine. In a certain foreign country designers adhere closely to that principle and strip all nonessentials from their important items of war equipment. For instance, in the single-seater fighter airplane of that country they have avoided all complicated instruments, intricate construction and extra weight. They have left out the self-starter. They have made the radio equipment readily removable so that in an emergency it will carry ammunition instead. They even have built the pilot's cockpit to accommodate only small men. In short, having determined that the purpose of the single-seater fighter airplane is to maneuver and to shoot, they have eliminated all items of equipment not germane to these purposes.—*Hon. Louis Johnson, Assistant Secretary of War, to the Conference of Procurement District Executives and Faculty and Students of the Army Industrial College, Washington.*

HAVING NOW OUTLINED OUR MISSION, OUR means and our procedure, let us examine briefly the engineering aspects of our problem. Basically the mechanization of land warfare rests on the fighting tank, aided and abetted by certain accessory and auxiliary combat vehicles. As you know, the tank is fundamentally a track-laying agricultural tractor refined and specialized for use as a combat vehicle by the addition of armor plate and guns and with greatly increased speed. Let me particularly emphasize that the fighting machine must be a *track-laying* machine because such a machine has much greater mobility over the rough, muddy, and varied terrain of the battlefield than any wheeled vehicle we know of. Only the track-laying machine has a tactical or off-road mobility roughly equivalent to that of the fighting foot soldier, or infantryman, whom it usually must assist and more and more often replace.

However, the tank differs from its progenitor, the agricultural tractor, as a race horse differs from a Percheron. A 10-ton commercial tractor has a maximum speed of some six or seven miles an hour with its engine of sixty to seventy-five horsepower, and carries no pay load on its back; whereas a modern 10-ton tank uses about two hundred and sixty horsepower to propel it at speeds up to forty-five miles an hour, and at the same time must carry on its back a "pay load" of armor, guns, ammunition, men, and equipment amounting to from thirty to forty per cent of its gross weight of ten tons. This simply means that in the tank the engine and power train must be of the highest performance and lowest weight, and there must be provided a flexible suspension system and tracks of long life and low resistance to traction. It is for this reason that we consider our modern light tank a descendant of which the original Holt tractor may well be proud.—*Maj. Gen. C. M. Wesson, Chief of Ordnance, to the Society of Automotive Engineers, Detroit, Mich.*

I AM AFRAID THERE IS A TENDENCY IN THE United States to think that the science of aëronautics has reached its zenith; that airplanes capable of easily crossing the oceans and returning, nonstop, are figments of a Jules Verne imagination. You gentlemen know that we have hardly scratched the surface in possibilities of large airplane development. The so-called superbombers of today are actually nothing but small prototypes of the airplanes of the near future. It was only a few weeks ago that two bombers of the British Air Force flew nonstop from Egypt to Australia—a distance of 7160 miles. The big airplane of "tomorrow" is a certainty. Normal progress alone will produce it; but if any country's national policy dictates its necessity, development will be greatly accelerated. I believe that any of our large airplane companies would be glad to contract to build a bomber capable of a tactical range of 10,000 miles. If American airplane manufacturers can build such a bomber, it can be done in other countries. What is more, it will be done. In fact, we do not know that it is not already being done.—*Maj. Gen. Frank Andrews, commanding the GHQ Air Force, to the National Aëronautical Association, St. Louis, Mo.*

OUR REQUIREMENTS AS TO TYPES OF MILITARY motor vehicles may be broadly divided into four gross weight classifications, as follows:

Extra-light Class (gross weight less than 6000 pounds, pay load one-half to three-fourths of a ton).—These are command and reconnaissance vehicles of the passenger-car and commercial carry-all classes, utility trucks, weapons and combat ammunition carriers and prime movers of light cannon such as the antitank gun. . . . .

Light Class (gross weight 9000 to 10,000 pounds, pay load 1½ tons).—These are light cargo vehicles comprising our combat and field trains, prime movers of light artillery, engineer dump trucks, light repair vehicles, etc. They are found in the immediate supporting elements of the front-line troops.

Medium Class (gross weight 13,000 to 15,000 pounds, pay load 2½ tons).—These are essentially our prime cargo carriers and troop-movement vehicles, comprising our rearmost supply and supporting transport. In this class we also have trucks for towing medium artillery, searchlight transport, certain types of repair trucks, etc.

Heavy Class (gross weight approximately 30,000 pounds, pay load 5 to 7½ tons).—The requirements of these vehicles are relatively limited compared with the other classes and include prime movers of heavy field and antiaircraft artillery, Air Corps field servicing trucks, etc.—*Maj. Gen. Henry Gibbins, Quartermaster General, to the Society of Automotive Engineers, Detroit.*

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Professional Digest

The following abstracts are based on current periodicals and events and aim to present a wide range of facts and opinions regarding recent developments of professional military interest. Quotation marks are omitted but sources are indicated.

A NEW CHEMICAL COMPOUND FOR VIRTUALLY complete protection for soldiers and civilians against the burns of mustard gas, was announced recently by officials of Hobart College, according to an Associated Press dispatch. The discoverer is Dr. Ralph H. Bullard, professor of chemistry, member of the American Chemical Society and several honorary scientific organizations, formerly an industrial chemist.

Until today, according to the Hobart announcement, the only protection against mustard gas has included gas masks and rubberized clothing. Masks afford no protection against severe burns and blisters on parts not covered by the mask. To protect the body, rubberized clothing was developed, but this protection is questionable at its best. Rubberized clothing is intolerable after relatively short periods because it prevents evaporation of body moisture. Also it frequently is not available when needed most, particularly in civilian populations.

The new antimustard preparation, sprayed on clothing, will remain effective for several months. Neither water nor ordinary temperatures have any effect on the compound, and clothing may be cleansed without destroying its effectiveness. Mustard gas coming in contact with treated clothing immediately is neutralized and becomes harmless as the air itself. The preparation is not injurious to human beings and treated clothing can be worn without any discomfort whatever.

THE SEARCH FOR WEAPONS TO MEET ARMORED attacks is going on in all armies, the *Infantry Journal* states. Mobility conflicts with penetrating power. Power conflicts with weight, concealment, and ammunition supply. Weapons suitable for rear-area defense are too large for front-line use. Guns that will stop heavy tanks are uneconomical against light tanks. Is more than one type of gun necessary? Many so believe and assert that the front-line units must have a light but powerful weapon for their own protection—an antitank rifle.

The Solothurn X18 20-mm. rifle is devised for use not only against armored vehicles but also against observers behind armor, snipers, machine-gun nests, antitank guns, and loopholes in walls and houses. It uses high-explosive shell, armor-piercing shot, semi-armor-piercing projectile, and tracer shell. It is automatic-loading, single-firing, and can be handled by one man. It is said that the average gunner can score a hit on a target 20 inches square at 550 yards and that 1-inch armor can be pierced at this range.

The following data are given: Length of barrel, 35.5 inches; grooves, 8; weight of barrel, 21.3 pounds; weight of rifle, 92.5 pounds; total length, 69.5 inches; average weight of cartridge 0.31-pound; average length of cartridge, 6.7 inches; weight of 5-round magazine empty, 2.9 pounds; weight full, 6.16 pounds; weight of 10-round magazine empty, 3.28 pounds; full, 9.7 pounds; muzzle velocity, 2375 to 2500 feet per second. This muzzle velocity should give a 20-mm. projectile the power to pierce 1-inch armor at 550 yards. A rifle of 92.5 pounds is a big load for one man, but it can be carried on the shoulders of two men when they are not under small-arms fire. It is not known what armies are actually using this weapon but it is said that the British and German armies favor it for the lower infantry echelons.

IN CONNECTION WITH THE PROGRAM TO TRAIN the youth of the nation in preparation for the expected increase in our air forces, it is planned to open the huge war-time naval ordnance plant at Charleston, W. Va., as a school for training ground forces for the Army and Navy and for commercial aviation. The plant was built during the World War to manufacture naval armor plate and armament, but hostilities ceased before it began production. Since then it has been in the hands of caretakers; its operation for the manufacture of armor plate was never considered to be economical. Only the necessary equipment needs to be added to the present buildings to prepare it for the training program.

DUE TO THE CORROSIVE NATURE OF SMOKE-producing materials, special instructions have been issued by the War Department governing the laying of smoke screens from airplanes in peace-time operations. The following restrictions now are to be observed: Smoke-producing material is not to be released at altitudes greater than 300 feet above ground, or in the vicinity of, or within a horizontal distance up-wind of twelve times the height of discharge from, personnel, live stock, buildings or other structures, equipment, conveyances, cultivated areas, or other objects whose damage might result in expense to the Government, except personnel or Government equipment involved in a tactical exercise and suitably protected. Smoke-producing material is not to be released when the wind velocity is greater than twenty miles an hour. Restrictions of the same nature also govern the firing of artillery shell, mortar shell, Livens projector shell, land mines, and chemical cylinders when filled with smoke-producing agents. Government equipment contaminated with the corrosive acids produced by liquid smokes is to be washed with water immediately after conclusion of the tactical exercise in which smoke was used.

A NEW FIGHTING AIRPLANE THAT CAN TAKE off and climb out of sight in ninety seconds has been offered by the Curtiss-Wright Corporation as a potential defense against high-flying bombers, according to the Associated Press. The new defense craft is called an "interceptor" of bombing planes. To intercept them it must quickly reach their altitudes. It can soar 5000 feet in 1.6 minutes, 10,000 in 2.8, 15,000 in 4.2 and 20,000 feet in less than 6 minutes. It is capable of cruising at more than 300 miles an hour at 17,500 feet, and can climb easily to 35,000 feet with its 2-speed supercharger and oxygen for the pilot.

The ship weighs slightly more than 4000 pounds with a full load. It is only 35 feet across its low-slung wings, and 26.5 feet from cowl to tail. The landing wheels retract into streamlined nacelles. On the 96 gallons held by its gasoline tanks, it can cruise 600 miles at normal speed.

The single-place plane has armor plate protecting the fighting pilot from behind and below, the most common directions from which death strikes war fliers.

In the nose the ship carries twin machine guns—one caliber .30 and one caliber .50—which are synchronized to fire through the 3-bladed constant-speed propeller. That propeller, plus duplex superchargers on the 600-horsepower Wright Cyclone motor, make for the phenomenal rate of climb.

IF MODIFICATIONS, NOW CONTEMPLATED, ARE carried out, the Browning machine rifle will be a more efficient weapon for cavalry use as regards stability, cooling, accuracy, and range than the Browning automatic rifle. Representations have been made, according to the *Army and Navy Register*, to the Chief of Cavalry to have the Ordnance Department modify the Browning machine rifle, model 1922, in the same manner that the Browning automatic rifle has been changed for the Infantry. The changes will reduce the weight to be carried by at least one-half and the weapon will be easier to handle when

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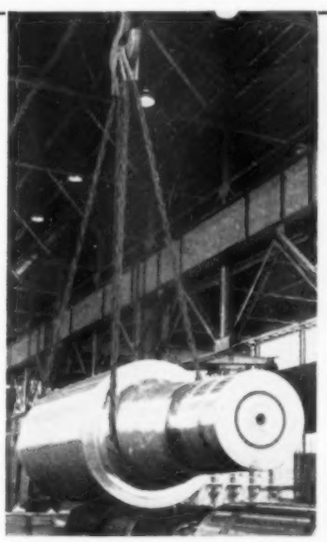

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hot than is the present light machine gun. The Cavalry Board has indicated a desire to test a machine rifle so modified as a possible replacement for the present light machine gun, model 1919 A4, now used by the light machine gun platoons of the rifle troops.

INSTRUCTIONS HAVE BEEN ISSUED BY THE WAR Department governing the status of pamphlets, drawings, etc., of the new Army rifle, caliber .30 M1. Certain matters pertaining to the work of the Ordnance Department are considered confidential; such as detailed drawings of important tools, jigs, etc., descriptions and photographs of manufacturing processes. These matters are classed as "Restricted." However, this classification has been removed from other items. War Department instructions pertaining to the status of Ordnance Department nomenclature follow:

1. Notes on matériel and wall instruction charts pertaining to the U.S. rifle, caliber .30 M1, in Ordnance Department standard nomenclature list B-21, are no longer classed as "Restricted" and the marking should be crossed off. 2. Detailed drawings, descriptions of manufacturing processes, detailed drawings of important tools, jigs, fixtures and gages, route sheets, and photographs of manufacturing processes pertaining to the following components of the U. S. Rifle, caliber .30 M1, are classed as "Restricted" under the provisions of A.R. 330-5: receiver, bolt, operating rod, and handle. In addition, drawings and descriptions of such tools, jigs, fixtures, gages pertaining to other components which may be developed and are of such a nature that their design should not be disclosed will be classed as "Restricted."

OF A SUPPLY OF 2500 OF THE NEW SEMIAUTOmatic rifles to be manufactured for the National Guard by Springfield Armory during the year ending June 30, 1939, a number sufficient to equip an entire infantry regiment will be issued to Oregon. Having been notified of this allotment, Maj. Gen. George A. White designated the 186th Infantry to be so equipped, basing his selection on the record in marksmanship made by the regiment. It received fourth place in national ratings for the Pershing trophy in 1937 and third place in 1938. Distribution of the new weapons is scheduled to begin April 1, 1939.

A DIGEST OF ANTITANK DEFENSE IN SPAIN, published in the *Army and Navy Journal*, specifies the following characteristics for a good antitank weapon: The projectile should be able to pierce armor at an angle of incidence of 60 degrees within a range of 550 yards. The shell should carry an explosive charge sufficient to cause serious damage within the tank; speed of fire is of prime importance due to the limited range in which a tank is visible as a target. The antitank gun to be used in the front lines should be easy to camouflage, have a low silhouette and be easily handled and transported. One gun to 275 yards of front is considered mandatory.

Five antitank guns are being used in Spain: the Hotchkiss 13-mm. and 25-mm.; the Oerlikon 20-mm.; the German Rheinmetall 37-mm. and the Bofors 40-mm. Of these, only the Oerlikon has given satisfaction. The 13-mm. Hotchkiss is eliminated because it fires solid shot, the German 37-mm. because of slow rate of fire, and the Hotchkiss 25-mm. because of excessive power. The Oerlikon gun penetrates the 1-inch armor of medium tanks within a range of 500 yards and its rate of fire is practically double that of the 25-mm. Hotchkiss with only one-third its weight. The 20-mm. cannon might even be replaced by an antitank rifle of the same caliber which is now under study.

A NEW TYPE OF INCENDIARY BOMB, NOW POSsessed by the British Government, recently was described by A. R. Astbury, technical adviser to the British Home Office. The

bomb is so light and small that the latest type of bomber could carry 2000 of them and drop them at the rate of twenty a second.

The new missile is called the "kiloelectron" and is composed of inflammable metal magnesium and "something else," according to a dispatch in the *New York Times*. The priming composition requires no external supply of oxygen and burns at a temperature of about 2500 degrees centigrade for a period of 40 to 50 seconds, which is long enough to melt and ignite the magnesium tube. The molten magnesium burns for 10 to 20 minutes at a temperature of about 1300 degrees centigrade (1494.50 Fahrenheit).

The bomb does not explode, but as the magnesium melts, jets of flame appear and pieces of molten magnesium may be thrown as far as fifty feet.

A RETRACTABLE AUXILIARY WING THAT FOR landings and take-offs to all intents and purposes converts a loaded, fast-flying monoplane, at the will of the pilot, into a slower and more manageable biplane, has been devised by the Fairey Aviation Company (British aircraft manufacturers) and is to be embodied in a new 30-passenger, low-wing monoplane airliner by order of the British Air Ministry, according to a dispatch in the *New York Times*.

When retracted, this new auxiliary wing lies under the after part of the main wing so closely as practically to form a part of it. In the halfway position it lies with its forward half under the main wing with its trailing edge standing out behind it, the two wings being almost parallel. Its effect in this position is to serve as an extra wing for an easy take-off and to turn the monoplane into a biplane with staggered wings. Extended further, the subsidiary wing takes up the position of a flap at an angle of thirty degrees in relation to the main wing. In this position it is used for slower landing.

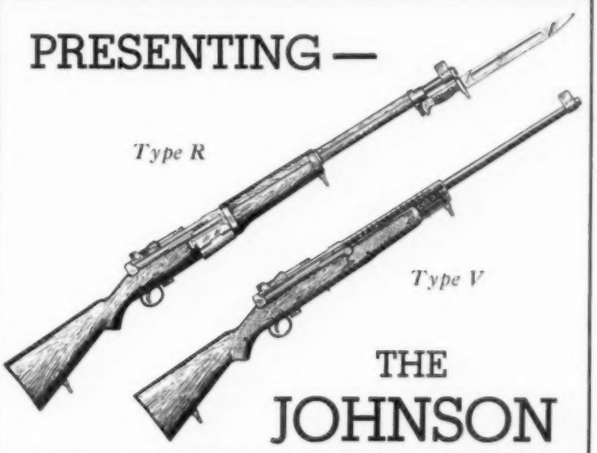
The auxiliary wing in Fairey's new aircraft reduces the wing loading of thirty-two pounds to the square foot, which is appropriate in cruising conditions, to twenty-five pounds to the square foot for the take-off. The landing speed is reduced by 10 miles an hour to 74 and a take-off speed under 100 miles an hour is claimed.

The new device is held to be the most promising of all the proposals for a retractable wing, which have ranged from the ordinary idea of a telescopic arrangement to extend the wing tip through the application of the Venetian-blind principle to a scheme making the lower biplane wings close up like scissors.

A DETAILED DESCRIPTION OF THE GERMAN GUN that bombarded Paris in 1918 is given in a recent issue of the *Command and General Staff School Quarterly*. The gun was emplaced near Crepy, a village near Laon, about seventy-five miles from Paris. The following data are given: Length of gun, 115 feet; outside diameter, 3.3 feet; caliber, 8.27 inches; weight of gun, 400 tons; weight of carriage, 500 tons; range at 52 degrees elevation, 79.5 miles; highest point of trajectory, 24.8 miles; time of projectile flight, 3.5 minutes; cost of gun, 11,200,000 marks; cost of each round, 35,000 marks; total rounds fired, 320.

The gun required relining after firing sixty-five rounds. To allow for wear of the bore, the sixty-five shells were numbered, each being made slightly larger than the preceding one. The shells were calibrated from 21 to 23.5 centimeters (8.4—9.4 inches). The bombardment of Paris began on March 23, 1918. Through its efficient secret service, the German GHQ knew within four hours the result of the first two shots fired. When the German retreat began, the gun was taken back to Germany on the last train that got past Soissons. It eventually was taken to Cologne where it disappeared without trace. For further data see "The Paris Gun," ARMY ORDNANCE, Vol. 10, No. 59, p. 329, and "Behind the Paris Gun," Vol. 16, No. 91, p. 10. Lieut. Col. Henry W. Miller, Ord. Res., a member of the faculty of the University of Michigan and a charter member of the Army Ordnance Association, is the author of the book, "The Paris Gun," 1930.

PRESENTING —



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- **Barrels:** Changeable in four seconds; U. S. Springfield M1903, Enfield M1917, Remington, Winchester or Savage caliber .30-'06 barrels adaptable to the Johnson, and may then be interchanged without adjustment of any kind.
- **Optional Features:** Wood or plastic stock with or without hand-guards of same materials. Detachable bayonet for Types R or V optional.
- **Manufacturing:** Maximum and minimum models have been made from production drawings to prove the manufacturing limits and absolute interchangeability of parts from one rifle to another. Thus, Johnson rifles can be manufactured in vast quantities on relatively short notice under ordinary mass-production methods.
- **Military Training:** Ease of handling and unusual simplicity of mechanism enable quicker training of riflemen than is possible with ordinary bolt-action rifles.
- **Functioning:** Severe firing indicates that the Johnson rifle is not dependent upon any lubrication for reliable functioning. The Johnson rifle has fired 2400 continuous shots in ninety minutes without cleaning, oiling, or cooling.
- **Reference:** See November 1938 issue of "The American Rifleman" magazine.

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Ordnance in Review

ROCKETS, PART I

BY LIEUT. COL. CALVIN GODDARD, ORD. RES.

THE appearance, in the January-February 1939 issue of ARMY ORDNANCE (Vol. XIX, No. 112, p. 225), of Maj. James R. Randolph's article, "What Can We Expect of Rockets?", brings to attention a war engine long disused and disregarded. Indeed, today so little is known of the history of the rocket and its employment in warfare, that a brief survey of these may not be amiss.

The origin of the rocket is lost in antiquity. It is conceded, however, that its birthplace was probably in the Orient—the evidence in support of this theory being much stronger than that tending to fix the nativity of projectile weapons (cannon employing gunpowder as a propellant) in the same locality. Thus we have the oft-quoted passage from the life of Apollonius Tyanaeus by Philostratus (A. D. 172-245) to the effect that:

"These truly wise men (the Oxydracae) dwell between the rivers of Hyphasis and Ganges. Their country Alexander [the Great] never entered, deterred not by fear of the inhabitants, but, as I suppose, by religious motives, for had he passed the Hyphasis he might doubtless have made himself master of all the country 'round them; but their cities he could never have taken, though he had led a thousand as brave as Achilles, or three thousand such as Ajax, to the assault; for they come not out to the field to fight those who attack them, but these holy men, beloved of the gods, overthrew their enemies with tempests and thunderbolts shot from their walls. It is said that the Egyptian Hercules and Bacchus, when they invaded India, invaded these people also, and having prepared warlike engines, attempted to conquer them; they in the meantime made no show of resistance, appearing perfectly quiet and secure, but upon the enemy's near approach they were repulsed with storms of lightning and thunderbolts hurled upon them from above."

Many have been the students who have chosen to interpret this passage as indicative of the actual use of *guns and gunpowder* by the Oxydracae. But that such epochal advances in the art of war could, once established, have become lost, not to be rediscovered until around 1300, appears hard to believe. Much easier is it to conceive that the "lightning and thunderbolts" described consisted of some form of rocket rather than projectiles impelled by gunpowder from fixed pieces of ordnance.

IN Europe, the military uses of rockets stem from periods now remote. Thus we find them described in "De la Pirotechnica" (1540), in "Mysteries of Art and Nature," by John Bate (1654), in the "Kleines Handbuch für neu Angehende Büchsenmeister und Feuerwerker," by Johann Baptist Veit Koch (1770), in the "Bombardier and Pocket Gunner," by Capt. R. W. Adye (1803), and, more importantly, in "Traités Militaires," by J. Hanzelet (1598). I say more importantly, because Hanzelet discusses *and illustrates,* the uses of rockets as instruments of offense rather than mere devices for signaling or illumination. But their employment in this guise prior to 1800 could not have been widespread, as Grose's "Military Antiquities" (London, 1801) makes no mention of rockets in any form, and this work, as students of military history know, is a decidely comprehensive treatise.

According to Scoffern ("Projectile Weapons of War," London, 1859), the British General Desaguliers undertoook (apparently in the closing years of the eighteenth century) an elaborate series of experiments looking toward the military employment of rockets, but with no success. His failure did not, however,

discourage Gen. Sir William Congreve who, in the introduction to his treatise on the "Congreve Rocket System" (London, 1827), says:

"In the year 1804 it first occurred to me that, as the projectile force of the rocket is exerted without any reaction upon the point from which it is discharged, it might be successfully applied, both afloat and ashore, as a military engine, in many cases where, from the violent recoil produced by exploding gunpowder, the use of artillery, according to the ordinary modes, is either entirely impossible, or at best very limited. . . . I knew that rockets were used for military purposes in India but that their magnitude was inconsiderable, and their range not exceeding 1000 yards. I knew also that some years since, several experiments had been made in the royal laboratory by General Desaguliers, then fire-master, for the construction of large rockets but that they had not succeeded and that very few of them would even rise off the ground."

Congreve then proceeds to recount the history of his endeavors to make the rocket a practical instrument of war, and the eighty-four pages of his work, which is close to folio in dimensions, are full of data of absorbing interest. The story of his three efforts to assault Boulogne with rockets from the sea—the first two brought to naught, one by the sudden development of unfavorable winds, another by the intervention of an armistice, reveals the unflinching determination of the man. For, refusing to concede defeat, he insisted upon a third attempt which, made on the evening of October 8, 1806, proved a success.

The operation was conducted by eighteen small boats of the British fleet. In some thirty minutes, 200 rockets were discharged, and within 10 minutes after the commencement of this strange bombardment, fire broke out within the city. This lasted from two o'clock on the morning of October 9th, until the next evening, so its effects must have been considerable, although the French were careful not to permit their adversaries to ascertain the extent of damage inflicted.

CONGREVE does not describe the rockets employed on this occasion, but he does tell us that he had, in the spring of that year (1806), discarded paper casings and substituted iron, with highly beneficial results. Thus he states:

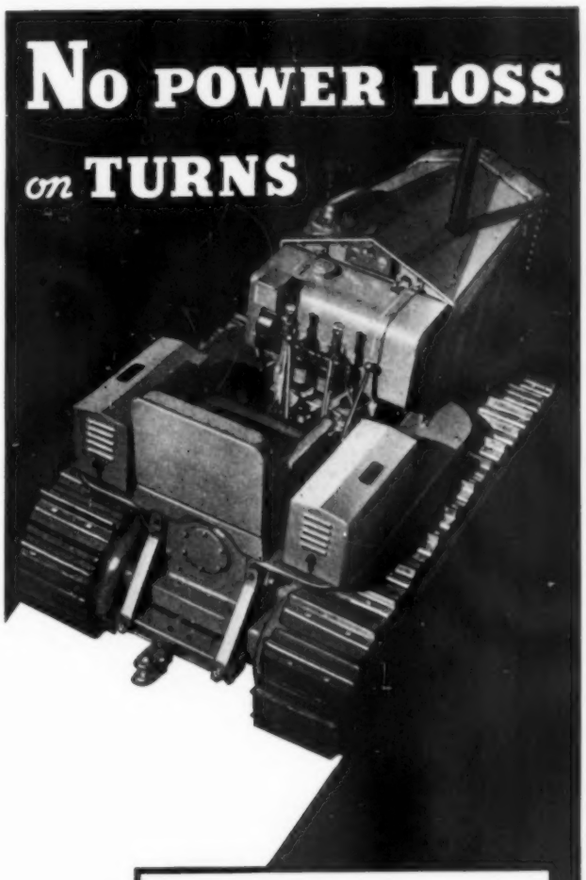
"This event answered my utmost expectations; I succeeded in constructing rockets weighing 32 pounds, capable of conveying as much carcass composition as a 10-inch spherical carcass, and which would, as an average, range 3000 yards. I discovered also, that the great length of the stick, given by the laboratory proportions, was by no means necessary to ranging rockets, and reduced that length from 25 feet to 15 feet, making the 32-pounder stick even less than that of the ordinary 18-pounder . . ."

Congreve's missiles were used again at the Battle of Copenhagen in 1807, and, sometime about 1809 or 1810, a rocket troop was formed at Woolwich under the command of a Captain Bogue. Attached to the Allied Army (Russia, Prussia, Austria) then engaged with Napoleon on the Continent, this unit, the only British one present on the field, distinguished itself at the battle of Leipzig (1813), but suffered the loss of its leader ere the action ended.

In 1817, Congreve commenced supplying the East India Company with his products, but apparently suffered the common fate of the pioneer in that the British Indian Government soon thereafter established its own rocket factory, leaving him much out of pocket as the result of his experiments and granting him no royalty or other recompense for the use of his inventions.

But the general was not discouraged. He soon managed to develop a 12-pound (actual weight) rocket which would penetrate 20 to 22 feet of solid earth at 1200 to 1300 yards, *and then burst*. Until then, a sod work 12 feet thick had been considered ample protection against 12-pounder field artillery. Here was something new and impressive.

By 1822, Royal Rocket Troops in the British service had



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been standardized under the following table of organization: 1 captain, 1 "second" captain, 2 lieutenants; 2 staff sergeants, 3 sergeants, 3 corporals, 7 bombardiers; 97 gunners, 36 drivers; 1 farrier, 1 carriage smith, 2 shoeing smiths, 2 collar makers, 1 wheeler; 1 trumpeter—Total: 160.

The troop was subdivided into 3 divisions, each of these comprising 10 sections, as follows: 10 heavy, armed with 6-pound rockets, each trooper laden with 6 of these in holsters, and each section transporting 1 cavalry (aiming) tube; 10 medium, armed with 3-pound rockets, each trooper carrying 12, and each section 1 tube; 10 light, armed with 1½-pound rockets, 24 to a trooper, and 2 tubes per section.

Attached to each division were 6 battalion horses, carrying 108 6-pound rockets, 216 3-pound rockets, and 432 1½-pound rockets. Wheeled transportation for the troop included: one 18-pounder carriage (4 horses) with jointed tube; one 12-pounder carriage (2 horses) with jointed tube; two 6-pounder "volley" carriages (4 horses); two 3-pounder "volley" carriages (2 horses); six light ammunition wagons (4 horses).

Such a unit carried into the field a total of 4120 rounds of rocket ammunition, varying in caliber from 1½ to 24 pounds, and 142 tubes or other devices for discharging these, as against the 6 field pieces and 1002 rounds of ammunition allotted a standard troop of horse artillery of that period.

The Congreve rocket as at first devised was of the conventional type, familiar to every celebrant of the Fourth of July or other national festival, with a stick attached tangent to the surface of its cylindrical body, and parallel to its long axis. But such an arrangement naturally produced such a wide dislocation of center of form from center of gravity, that little accuracy of flight could be expected or attained. So his later products were modified by relocating the position of the stick.

Congreve devoted much time and thought to devising elaborate drill and field-service regulations for rocket infantry, cavalry, field artillery, and bombardment groups (heavy artillery), both mobile and stabilized. In addition, he describes their use in ambuscading marching troops, the attack and defense of fortified places, the storming of fortresses, by infantry against cavalry, in naval operations, and as equipment of fire ships. In his infantry formations, one man in each ten transported a rocket tube of the 3- or 6-pound type. When the matériel involved heavier types of projectiles (9-pound or 12-pound), two men were required per tube, a half length of which was carried by each. Tubes were supported on four legs, and were longer than the cavalry type, measuring as much as 15 feet in some instances for the 9-pounders, and 20 feet for the 12-pounders. The remaining men each carried from 2 to 8 rockets according to caliber; *i.e.*, two 12-pounders, three 9-pounders, four 6-pounders, or eight 3-pounders. Discharge was initiated either with a portfire or by a flintlock attached to the tube, and actuated by a lanyard. He advocated the use of case-shot rockets, thus:

"The case-shot rocket is an application of the arm peculiarly well adapted for the use of cavalry or infantry in the field. Every round of case-shot rockets contains a greater quantity of carbine balls than a round of Shrapnell's shells of corresponding caliber, the bursting powder of the rocket case shot (the explosion of which is capable of the nicest regulation by fuse) being contained in a chamber in the rear of the charge of balls. As the rocket passes through, the air gives an increased velocity to these balls on the bursting of the case shot which is not the case with Shrapnell case shot. In fact, the bursting powder of the rocket case shot is so regulated that the balls would penetrate an inch plank if the rockets were at rest, and consequently, however small the velocity of the rocket may be at the time of the bursting of the case shot, the penetration of the balls will be always sufficient to produce the intended effect, whereas if the velocity of the Shrapnell shell is nearly expended at the time that it bursts, the balls fall harmless."

(*To be continued.*)

Book Reviews

TOMORROW'S WAR. By Stephen Possony. London: William Hodge & Company Limited. 8s. 6d.

MANY books have been published in recent years on the exclusively military side of modern warfare. This book, which is a translation from the German, considers the economic background of tomorrow's war. Mr. Possony's thesis is that "military force is no longer the strongest force, it is economic force which has become the greatest power in the modern world in the event of a great war of long duration." From this the author concludes that economic pressure, or a blockade and consequent interrupting production of the necessary war material, is the most effective method of winning a war.

In considerable detail he calculates requirements of guns and ammunition, airplanes, and the other matériel necessary for modern war and shows what this means in secondary requirements of raw materials, labor, transportation, fuel, etc. The author points to the failure of the general staffs of the various armies to anticipate with any degree of correctness the demands of the World War on national economies. He feels that the prophetic capacity of the modern general staff is no better than it was in 1914, and reaches the conclusion that "it is practically certain that all the more detailed schemes for mobilization are false." The point is that "once an economy is committed to a plan and arranged accordingly, it takes a long time to reorganize it, and such a reorganization means, to use military terminology, a decisive battle lost, because it cannot be accomplished without enormous losses." The author holds that to obtain the essential flexibility, private initiative is better than the controlled production characteristic of the totalitarian states.

This study of industrial mobilization presents certain novel views which are stimulating, although somewhat confusing to follow. His conclusions concerning sound economic organization of a country for war are certainly more favorable to the methods employed by the democracies than to the inflexible methods adopted under the dictatorships. D. A.

THROUGH THE FOG OF WAR. By Liddell Hart. New York: Random House, Inc. $2.50.

APPROPRIATE to these parlous times, the prolific and brilliant Liddell Hart argues the futility of war and cautions against repeating the mistakes of past wars in his latest book. Probably his threnody will not greatly influence the trend toward conflict, but is hoped that his delineation of past mistakes will point a moral as it certainly adorns a tale.

If this is not a new kind of history it is at least a fascinating variation of the old, and the author lifts the curtain and reveals the esoteric with true artistry. History is not fixed, but fluid and ever changing. Captain Hart, in keeping with this characteristic of his subject is entitled to revise his opinions at least once in ten years but in this book he is faintly reminiscent of a "Monday-morning quarterback." It is difficult to handle even a squad in battle but comparatively easy to tell how wars should have been won twenty years after, when all the paper work has been done.

Everyone is entitled to at least one hero, and every hero is entitled by courtesy and for the good of the people to become more heroic as he fades into time. Hart, with deliberation but no apparent malice, tears aside the toga to display the feet of clay. It is discouraging and disconcerting to have revealed the faults of the great men of war—their personal aggrandizement, their jealousies and intrigues, their refusal to admit a mistake

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and save a thousand lives. It would be almost incredible if not substantiated by the book that some went so far as to falsify their records and war diaries even to the extent of recording, with an eye for the future, detailed orders for battles that never took place.

To Americans, the most interesting parts of the book are those dealing with the A.E.F. Captain Hart's opinion is that the war was unnecessarily prolonged by General Pershing's determination, approaching blind stubbornness, to have the Americans fight as an army and not sent to fill the cadres of Allied armies. He deplores, as do all who stood on the heights before Chambley on September 13, 1918, the insistence of Haig on limited objectives for the St. Mihiel offensive. Better to have gone ahead and broken the faint line than to have engaged so soon in the grueling Meuse-Argonne. He reminds us that from GHQ at Chaumont came the timely warning, ignored by our Allies, of the last great German attack in May 1918. The mythical, but successful, American offensive in Alsace is not touched on.

A splendid work and one to be recommended to all students of military history. C. MCK.

Flight Into Oblivion. By Alfred Jackson Hanna. Richmond, Va.: Johnson Publishing Company. $2.75.

PERHAPS the chief claim to our attention of Professor Hanna's work is that it treats of an almost unknown phase of Confederate history. Never before, we believe, has the flight of the Confederate Government, with the capture of some of its leaders, and the thrilling escape of others, been put into one readable and exciting volume. The great amount of research which the author must have done in this almost untouched field and the painstaking manner in which he has pieced together the many scattered reports, letters, and references to form one narrative, readily can be appreciated by anyone who has attempted to gather data of those hectic last days of the Confederacy.

Although most of the book's content is given over to recording the flight of individual leaders and their subsequent adventures, the course of the war in its last days and the first beginnings of Reconstruction are not neglected. One of the most interesting features of "Flight Into Oblivion" is the complete story of the wanderings and final disposal of the gold of the Southern Confederacy. Rumor placed it at thirteen millions of dollars, and legend has persisted as to its burial. Professor Hanna dispells this by accounting for virtually every dollar.

The value and interest of the book's 320 pages are greatly enhanced by the 57 drawings and 15 maps with which it is illustrated, and by the complete bibliography and index. The author and publisher are to be complimented upon turning out such an interesting and attractive volume. F. W. F. G.

Dynasty of Death. By Taylor Caldwell. New York: Charles Scribner's Sons. $2.75.

HEREIN the familiar "munitions mongers" adorn a novel, or vice versa. This, in one aspect, is an excellent saga of the rise of American industry; namely, steel, oil, banking, railroads, mining, and munitions. More especially it is an able and thorough character study of a "robber baron," Ernest Barbour, "armaments king" of Barbour-Bouchard, and his family.

From the literary point of view the author attempts too much. Not content with a marvelous portrayal of a large family through three generations (1837-1910), not content with a dozen masterful characterizations of men and women of the Barbours and Bouchards, not content with a series of absorbing and highly dramatic incidents in the lives of vividly lifelike American characters—not content, in short, to write a remarkable novel, the author pours out frequent sermons against munitions mongers. Big industry, armaments rackets, perfidious negotiations, ruthless policies, hypocrisies, bribery, war fomentations, press control, international combinations, and other fiendish machinations

are crammed into an otherwise plausible novel. It is like too much pepper in an otherwise delicious soup—it spoils the entire dish.

The climax of the story is the death of Ernest Barbour. But the author cannot stop. Having until then thinly masked his real attitude toward the arms industry, he proceeds to state that the World War was fomented entirely by arms makers.

Taken all together, he indicts Barbour-Bouchard, Kinsolving Arms, Robson-Strong, Sessions Steel, Skeda, the agent Sazaroff, plus several capitalistic financiers in New York City, in that they did instigate and procure, through the press and lobbies, the Civil War, the Franco-Prussian War, the Crimean War, the Boer War, the Spanish-American War, the Russo-Japanese War, the World War; that they did chiefly import "slave" labor from Europe, pay wages in scrip, starve and kill off workers and miners, control all governments, control all newspapers, cause the existence of unhygienic conditions in factory towns, and other wickednesses, all to the loss, misery, bankruptcy, and bloodshed of America—a nation of conglomerated people who have become richest and most powerful, first and strongest in the world, who, in a few generations, have passed from log huts to skyscrapers, mud sloughs to boulevards, stagecoaches to streamliners—a people whose standards of living are higher than those of any in the world.

By all means borrow a copy of this book. It is a best-seller. It is full of disguised propaganda against munitions makers. It is nevertheless a compelling, stimulating, absorbing novel, and members of the Army Ordnance Association, at least, can safely separate the wheat from the chaff. M. M. J.

LORD ROBERTS. By Col. H. de Watteville. Glasgow: Blackie & Son, Ltd. Five shillings.

ONE of the encouraging signs of the past few years has been the increase of biographies, and the multiplication of readers of this class of work. The appearance of the modern type of biography—small, but by no means a mere thumb-nail sketch—has had much to do with this popularization. Of this field, Colonel de Watteville's "Lord Roberts" is a fine example. One of the "Series," so popular in Britain, it is short enough for the average reader, yet quite adequate.

The greatest *raison d'etre* of all biography—the development of the character of the subject—is well presented here. The path of Frederick Roberts, the gunner subaltern to Earl Roberts, the field marshal, is built step by step, in careful and logical fashion.

The exceptional length of Lord Roberts' active service (1852-1914) affords a splendid view of his two great cares, India and the British Army. Noteworthy to the reader is the gripping account of the Indian mutiny, with its horrors and its no less tremendous heroisms. As to the "Old Army," which he so largely fashioned, it must be remembered that despite its glaring defects, it was the force which, by quite literally sacrificing its life in 1914, saved Britain from certain disaster. It is no less than fitting that the life of "Bobs" should have ended within sound of its guns! F. W. F. G.

ELEMENTARY GUNSMITHING. By Perry D. Frazer. Onslow County, N. C.: Small Arms Technical Publishing Co. $2.

ONE has but to read the foreword to this handy volume to feel that he has a treat in store. And as he peruses the text which follows, each chapter convinces him in increasing measure that, for once, realization exceeds anticipation.

Samworth appears to possess an uncanny ability to ferret out individuals gifted with the talents and experience requisite to produce a work of consuming interest to sportsmen and arms lovers. Without the stimuli which he so deftly applies, these writers would remain anonymous, hiding their lights under bushels. In the present instance he deserves the heartfelt thanks of all exponents of the rifled tube for having introduced to them

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a man who, in addition to presenting a book abounding with information, some of which will fascinate all of them, and all of which will delight many, possesses the facility to present his material in such a manner that it carries the appeal of fiction.

Frazer's work is divided into seventeen short chapters replete with the data which one would expect to find in a volume of this nature, plus a great deal more which is tossed in "free for nothing." Indeed, one is amazed at the amount of information contained within its scant 200 pages. The author attacks his subject in orderly fashion, outlining in the first chapter the objects to be kept in mind by the beginner, then proceeding to discuss such items as models, textbooks, and reference works (Chapter 2); the shop and its equipment (Chapter 3); necessary tools—and others (Chapter 4), and so onward through discussions of labor-saving devices, materials and supplies, sights, telescopes, bluing processes, soldering and brazing, stock fitments, restocking, remodeling, and generalities, concluding with a most comprehensive list of makers and dealers in every type of gadget useful to the amateur gunsmith.

Finally, the volume gives evidence of excellent proofreading. Typographical errors are so few as to be almost nonexistent, and the composition is generally pleasing. In one or two instances, attempts have been made to crowd too many items into a single photographic plate, but apart from this, the work appears beyond criticism. C. G.

BURNING POWDER. By Douglas B. Wesson. Springfield: Smith & Wesson.

DOUGLAS B. WESSON, vice-president of the firm of Smith & Wesson and a lieutenant colonel in the Ordnance Reserve, is the author of a new handbook on pistol shooting appropriately called called "Burning Powder."

While the sixth edition to bear this title, the present manual contains so much new material that it is in reality a new book rather than a revision. "Burning Powder" is a 96-page, paper-bound manual a trifle smaller than the well-known "Ideal Handbook." It contains a wealth of pertinent matter on such subjects as revolver clubs, indoor range construction, care of arms, shooting instruction, sight adjustment, targets and rules, the N.R.A. and U.S.R.A. matches, etc.

There are special chapters by Ed McGivern on "High-speed and Aërial Shooting" and "Police Shooting" and a chapter entitled "Double-action Shooting" by Lieut. J. D. Leppert of the Saginaw (Michigan) Police Department. Lastly, there is a bibliography listing some thirty-one pistol books that have appeared since 1875. The book has over forty illustrations.

Colonel Wesson's handbook contains little or no advertising and is an exceedingly practical manual that may be recommended to all lovers of the one-hand gun. A. P. W.

GENERAL REGISTER OF FIREARMS AND EXPLOSIVES. By Dr. August Schrimpff. Munich: Verlag der Zeitschrift fur das gesamte Schiess- u. Sprengstoffwesen. Linen. 60 Reichsmarks.

THIS is a complete index, extending over thirty years (1906-1935), of the magazine of the renowned German publication of firearms and explosives issued by Dr. August Schrimpff. It is the first attempt to compile so comprehensive a reference to the literature on powder, explosives and firearms. Included in the subject matter is a special section on gas defense with references to the technical literature.

The volume is unique in this latter regard. The bibliography of gas defense at best is none too extensive. But it is decidedly rare to find an authentic reference work on the subject. Our technical catalogues in English should follow suit.

It goes without saying that any work bearing the approval of Dr. Schrimpff is acknowledged to be authentic and complete. This general register is no exception and is quite invaluable to the chemist as it catalogues a tremendous amount of valuable work done by the scientists of Germany in this field. O. E. D.